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ON THE ACTION OF SCREW PROPELLERS.*

By Mr. James Howden.

It may be asserted without much fear of contradiction, that during the last quarter of a century little or no progress has been made in improving the efficiency of the screw propeller. Increased experience has, no doubt, led more generally to a better proportioning of the surface and pitch of the blades for any special conditions, but no radical improvement has been made in the form or construction of screw propellers during that period, notwithstanding the numerous efforts to increase the efficiency of the screw as a propelling instrument. It appears to the writer that this lack of improvement and waste of effort has been owing chiefly to the fact that the defects which have been most persistently sought to be overcome, or corrected, are altogether or for the most part imaginary and not real, their conception having arisen from several prevalent erroneous ideas regarding the action of the blades on the water in which they revolve. In the course of this paper I propose to show that the supposed centrifugal action of the propeller blades does not and cannot exist under the ordinary conditions of a propeller at work; also that no large column or stream of water is thrown out from the propelling faces of the blades either backwards or angularly when the vessel is fully under way. The propeller blades in such a case can only in a very slight degree impart any motion, backwards or otherwise, to the water against which they glide. Experience has pretty fairly shown that screw propellers are now generally made of judicious proportions in regard to the number and surface of their blades, and also as regards their pitch and outline, so that improvement must be sought for in some other direction than these.

The chief defects of screw propellers, as now made for ocean steamers, are those, so far as I can discover, which arise from the great weight and thickness it is necessary to make them in order to prevent their breakage. The first and most essential quality in a propeller is that of sufficient strength, and every other desirable quality must yield to this, if their retention is inimical to that on which the very existence of the propeller depends. This great thickness of blade, found necessary to give strength, produces, or at least greatly increases, the following serious practical disadvantages:—(1) A large unproductive absorption of the engine power in driving the propeller itself. (2) Retarding the progress of the vessel by increasing, in some ratio of the thickness of the blades, the reduction of the pressure of water under the stern of the vessel. (3) Causing undue wear of the stern bearings in ordinary working, and injurious shaking of the afterpart of the vessel and rudder, and severely straining the propeller shaft when the vessel is pitching and laboring in rough weather.

In considering the first-mentioned defect, the undue absorption of engine-power by the revolution of the thick blades of the propeller, I do not forget what Professor Rankine, Mr. Froude, and others have pointed out, that submerged ship-shaped bodies of different sectional areas, but equal surfaces, will have practically equal resistances, if moved at a velocity which will allow the water to fall in behind as fast as it is displaced forward. Experiments, however, also nearly prove that, at certain velocities, the water will fail to fall in sufficiently fast behind such bodies, and the resistance to their motion will be increased by the diminution of pressure or the formation of a partial vacuum behind them. If we suppose the larger body to have twice the sectional area of the smaller amidships, the speed required to form this partial vacuum will be considerable less for the larger body than for the smaller, and, after it is formed, the resistence therefrom will rapidly increase with each increment of speed. It is likewise a plain deduction that if this partial vacuum behind this body were equal, the resistance to the motion of the body with twice the section would be twice that of the other. Then, as the velocity to produce the same vacuity or negative pressure behind per unit of surface must be much greater in the supposed case of the body with its midship section only half that of the other, we can easily conceive that, at a certain equal velocity, the negative pressure behind the smaller body will only be half that behind the larger body.

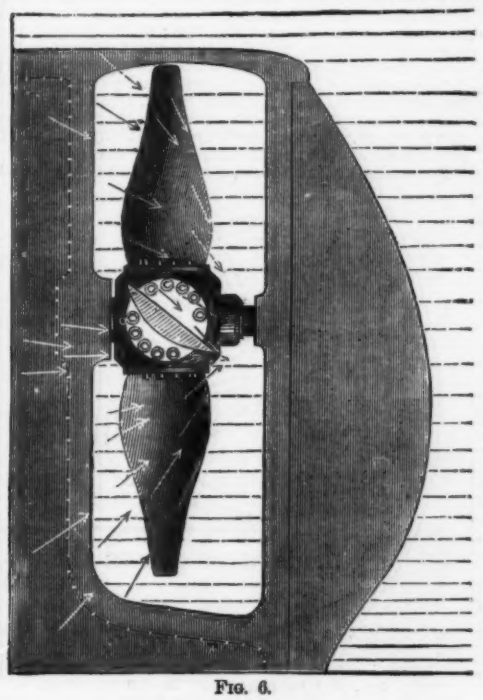


Fig. 6.

The actual resistances in these circumstances, and consequently the power necessary to overcome these resistances, will, therefore, be as 4 to 1, the larger section having double the area and twice the pressure of the smaller. I am not prepared to say at what velocity any two bodies having equal surfaces and relative sections, such as I have supposed, would have their respective negative pressures exactly 2 to 1, but it is quite within the range of investigation. I may say, however, I have no doubt that the differences in the thickness of the blades of propellers of equal diameters could be made such that the relative resistances arising from negative pressure may be, when working at the same velocity, 4 to 1, if not even of a still greater difference.

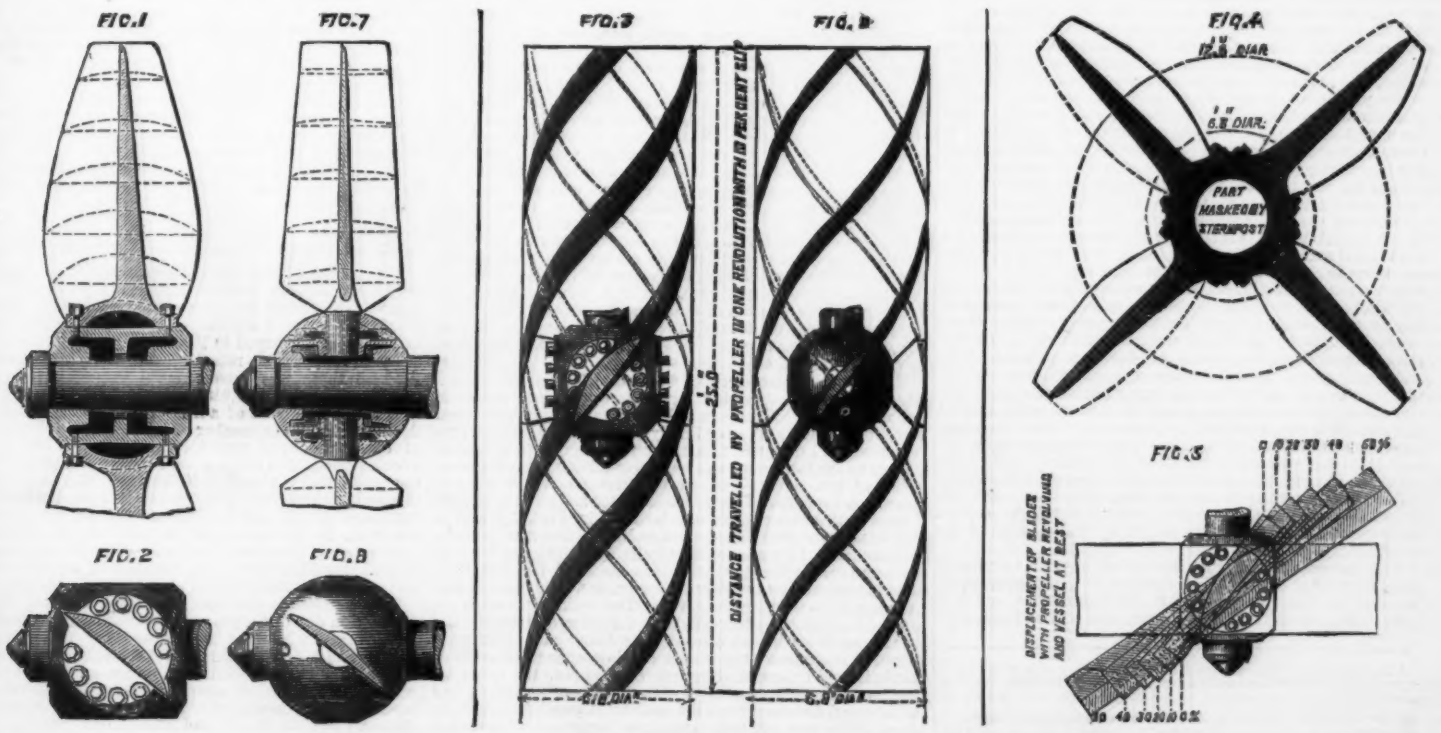
In order to elucidate the subject more fully, I will take the case of a propeller now in use in a large Atlantic steamer, the consideration of which, under actual working conditions, will also give me the opportunity of referring to the several generally received opinions regarding the action of the screw propellor to which I have already referred. The dimensions of the propeller, I may remark, have been very slightly altered to avoid unnecessary fractions. This propeller has four cast iron blades bolted on a spherical boss in the usual manner. Its diameter is 20 ft., and pitch 27·77 ft., the boss being 4 ft. 11 in. in diameter. Each blade has 28 square feet of surface. The whole propeller weighs 17¼ tons. When this propeller is driven at sixty revolutions per minute, and the slip is 10 per cent.—a slip which, I may say in passing, is rather over than under the average of the best class of full-powered ocean steamships—the direct forward progress of the vessel and propeller is 25 ft. per second, or 14·8 knots per hour. This propeller is shown in Figs. 1, 2, 3 and 4.

In Fig. 1 a blade is shown on its flat with a section of the boss; and in Fig. 2 a blade is shown in section on a diameter of 6 ft. 8 in., or one-third the diameter of the propeller. Fig. 3 shows the propeller also sectioned on this diameter, and the spiral passage through the water which would be made by the blades at this diameter in one revolution, the slip being 10 per cent.

Fig. 4 is a projection of the propeller at right angles to its axis, in section through center line of each blade, or what I may term the midship section of each blade. The thickness of each blade, on this line of section, is 1¼ in. at the point, and 11 in. at the root, measuring between the straight lines produced to the extremity at the outer end and to the boss at the other end, not taking notice of the rounding off at the tips, or the filling up curves where the blades join the boss.

Let us now consider the various velocities of the blades at different points from the center of this propeller when working at the speed before mentioned. At 5 ft. diameter, or quite close to the boss, the velocity of the blade through the water consequent on its revolution and the forward movement of the vessels is 29·52 ft. per second. At one-third, or 6 ft. 8 in. diameter, it is 32·62 ft. per second. At nearly the half distance of the blade from boss to extremity, 12 ft. 6 in. diameter, the velocity of 46·55 ft. per second; and at the ex-

* Institution of Naval Architects.



THE ACTION OF SCREW PROPELLERS. BY JAMES HOWDEN.

treme diameter 67·62 ft. per second.† It must be evident that blades of the thickness shown passing through the water at these enormous velocities are far too full in their section, especially towards the roots, to permit the water to fall in behind sufficiently fast to prevent the formation of a partial vacuity. The section of water displaced by each blade from where it joins with the boss has an area of 4·03 square feet, or 16·12 square feet, in the four blades, and in each revolution of the propeller, or per second of time, the amount of water displaced by the four blades is 661·5 cubic feet. The water displaced by the boss must also be taken into account, and in the case before us the area of the boss —4 ft. 11.—less the area of the part masked by the cylindrical boss on the stern post, say of 3 ft. diameter, is 11·947 square feet, which, by the actual distance 25ft. passed through by the vessel per revolution, is 298.675 cubic feet per second. The amount of water displaced up the propeller per second is, therefore, 661·5 + 298·675, or a total of 960·175 cubic feet. This great thickness of blade, involving, as it must do, a large amount of resistance, is, however, found necessary to give sufficient strength in cast iron to stand the Atlantic navigation, and the thickness must be much less when the blades are cast in steel.

I now come to consider the matter of slip, and in connection therewith, the extent of the water set in motion backwards by the thrust of the screw, and to compare this with that of the displacement of the blades themselves when working without slip. Were the vessel to maintain a speed equal to the pitch of the propeller, or, in other words, were the screw to propel the vessel without slip, and the propelling faces of the blades a true screw, there would be, and could be, no motion whatever of the water backwards or sideways due to the thrust of the propeller, because no motion would have been imparted in that direction by the revolution of the blades, and the only movement or displacement of the water that would then require to be considered would be that caused by the blades themselves and the part of the boss not masked by the stern post. When slips occurs, however, there is a certain amount of water put in motion backwards by the propelling faces of the blades, but which, when the slip is moderate—as it should be in all properly designed steamers—is trifling in amount when compared with that displaced by the blades themselves in forcing their way through the water.

In the case of the propeller under consideration, the actual motion given to any particle of water by the blades at the different diameters already mentioned consequent on the slip, are as follows :—At 20ft., where the blades measure 22in. across on the circumferential line, the motion is ·812in. ; at 12ft. 6in. diameter, where they measure 53in. across 2·44 in. ; at 6ft. 8in. diameter, when the measurement across is 52in., 2·53in. ; and at 5ft. diameter, where they are 43in. across, the motion due to slip is 1·83in. The extent of motion due to the slip at any given diameter of the blades is ascertained by dividing the distance passed over by a point in the blade on the given diameter in one revolution, by the length of the arc of the circle on the breadth of the bladeat that diameter. The quotient gives the number of times the whole breadth of the blade at that point passes over new surfaces of water in one revolution. Then, as the blade can only act continuously on any one particle of water from the time of its coming in contact with it at its forward or leading edge until it leaves the particle at its after or following edge, the whole extent of the motion which the water receives when in contact with the blade is equal to the whole slip of the revolution divided by the number of times the distance passed over the blade in one revolution is greater than the breadth of the blade.

It must also be observed that the actual slip of the water is less than the slip of the propeller at any given diameter in the proportion of the base to the hypotenuse of a right-angled triangle in which the base is equal to the circumferance of the propeller at the given diameter and the perpendicular equal to the pitch of the screw. The diagrams Nos. 3 and 4 show the amount which would be displaced by the blades, supposing the screw worked without slip, and also the additional amount of water displaced by the blades when subject to 10 per cent. of slip. The dark colored part represents the displacement of the blades themselves, and the red-colored part the additional displacement due to the slip.

It will be seen that displacement caused by the slip is small in comparison with that caused directly by the blades in their passage through the water, and from the consideration of the diagrams it will be evident that when a screw propeller is working under proper condition, it cannot discharge a large column or stream of water backwards or angularly from its propelling face, as is so generally supposed, and that little loss of effect is sustained by this action ot the propeller. It may be argued that the actual retrogression of the water caused by the slip may be greater than the mere loss of direct forward motion by the propeller, as the momentum imparted to the water by the blade in passing over it may continue to give motion to it in the same direction for some distance after the blade has passed. The continued motion from this cause, I believe, quite unappreciable in extent. The whole motion of the water in the line of the vessel's progress is small, and it must be noticed that the several amounts of motion already mentioned, as consequent on the slip at the different diameters of the screw, represent the accumulated motion caused by the passage of the whole breadth of the blade over a particle of water at any of these diameters, as the leading edge of the blade comes in contact with the water in a state of rest—currents caused by the vessel's motion not being considered. The mean amount of motion imparted to the water at any of these diameters, and the actual increase of displacement due to the slip, is, therefore, only half that of the accumulated motion. The propeller also, as it revolves, leaves the space behind each blade to be filled up by the contiguous water and from the peculiar section of the blades. The body being, as it were, all on one side, the water will obviously fall in more readily from the propelling face than the rounded back, and thus tend to destroy any slight motion backwards, imparted to the water by the passage of the blade.

Coming now to consider the effect of the revolution of the propeller at these high velocities, in producing or increasing the negative pressure at the stern of the vessel, it is evident, I think, that a partial vacuum will be formed behind the blades, increasing in degree and volume, etc., from the extremities towards the roots, the boss also adding to the extent of the vacuum. This vacuum, more or less in degree, I have endeavored to represent in the diagram No. 6, by the shaded parts behind each blade and the central boss. As the thick roots of the blades and the central boss will tend to carry the water forward with them, the space behind, in which a partial vacuum has been formed, must be filled up chiefly from the outer spaces between the blades. As the water of replacement of the vessel having its current flowing aft, or at least falling in from the sides towards the propeller, the vacuity behind the propeller will be filled most readily from the water front of it and immediately under the vessel's stern, thereby reducing the quantity of water which would otherwise support the vessel and thus increase the negative pressure.

I would, therefore, venture to say that the augmentation of the ship's resistance, consequent on the action of the screw which Mr. Froude has so frequently directed attention to in his admirable papers bearing on the subject, is but in a slight degree due to the thrust of the screw, as has been assumed, and chiefly to the displacement of the water by the screw itself in its revolution, as I have endeavored to explain. Another element of considerable importance, in connection with this subject, is the effect of the slip in increasing the detrimental action of the propeller by increasing the extent of the vacuity behind the blades. This will be more apparent by reference to the diagram No. 5, which shows the different sections of water that would be displaced by the revolution of the blades at different percentages of slip. The diagram shows the displacement of the blade itself, and with the slip added when working at slips varying from 10 to 50 per cent., also when revolving and the vessel at rest. The displacements shown are those on a diameter of 6ft. 8in. of the propeller.

It will be evident that the section of water scooped out, or displaced by the blades at different parts of their diameters, is increased as the slip increases, without reference to any backward currents. It appears to me, therefore, that all experiments made with a view to determine the amount of augmentation of resistance caused by the working of the screw under, or near to, the stern of the vessel, should take into account the nature or character of the propeller, and especially the blades, and also the amount of slip occurring during the experiment. I will venture to say that, with two different screws of the same diameter and pitch, and giving the same forward progress to the vessel, results may be had where the augmentation of resistance to the ship's progress due to the propellers will vary very materially, and also the power required to drive the propellers themselves.

From these considerations, may I venture to suggest that another might be added to the various elements into which the "indicated thrust" has been divided by Mr. Froude in his paper, "On the Ratio of Indicated to Effective Horse Power," viz., the resistance due to the revolution of the propeller itself, arising from the formation of a partial vacuum behind it? The introduction of this new element would, no doubt, have the effect of modifying the percentages of No 2 and No. 3 of Mr. Froude's force factors.

Coming back for a moment to the snbject of the centrifugal motion, supposed by many to be imparted to the water against which the propeller blades act in their revolution, I would remark that it has always been a matter of surprise to me to find such an idea so prevalent. I can only imagine it has arisen from seeing the propeller throwing the water up and around on first starting the engines when the vessel was at rest. This movement of the water by the blades, however, can no more be termed centrifugal motion, than the broken water lifted by an oar when rowing can be so termed. If the propeller were moving in air on its axis and forward at the same time, each revolution a distance equal to its pitch, I consider the tendency to throw off radially any water adhering to the blades would not be great, but when fully immersed in water the tendency to set up such a motion of the particles in contact with the surface of the blades would be practically *nil* in any case, but if a partial vacuum be caused by the revolution of the propeller, this vacuum, forming more extensively towards the center of the propeller, as I have endeavored to explain, will cause the water to flow inwards instead of outwards.

This paper has far exceeded the limits I intended when I began to write it, though I have left out several points in connection with the subject I had proposed to touch upon. I will only, therefore, very briefly refer to an improved propeller which I designed about four years ago with a view to reduce so far the loss of engine power arising from the revolution of the screw itself and its effect on the ship's progress. A propeller of the same diameter and pitch as the one I have in this paper referred to is shown in Figs. 7, 8 and 9. The blades are steel forgings made by the Siemens' process, which material appears to be admirably suited for the purpose and far preferable to forgings made of the best iron. The blades are first machined all over, and then bent in a cast iron mould to the pitch required. The cylindrical roots are finished in the lathe to a uniform diameter and taper; and the socket holes in the central boss being also accurately bored to correspond, the blades are interchangeable. Each blade is held by one slightly tapered steel pin, the holes being bored in the boss parallel with the axis of the shaft, and all at equal distances from the center. A small detention pin fixed inside each pin hole against the larger end of the steel pins securing the blade prevents any possibility of the pins getting loose. The pin holes in the boss are filled up with Portland cement after the fixing had been completed, making the boss perfectly smooth without any projections whatever, and the fastenings completely protected from the action of the sea water. With this mode of fastening it is not necessary to make the boss so large in diameter as it is in the case of the other propeller, where the base of each blade must be of considerable diameter to give room for a sufficient number of studs and nuts. The boss is, therefore, only 4 ft. 4 in. in diameter, and the thickness of the blades at their extremities is ¾ in., and 4½ in. at 3 ft. from the center of the shaft, or on the line of 6 ft. diameter of the propeller. The total section of the four blades down to the boss is 6·45 square feet, against 16·12 square feet of the other propeller. The area of that part of the boss not masked by the 3 ft. diameter of boss on the stern post is 7·68 square feet against 11·94 square feet of the other propeller. The total weight of the propeller complete is 7¼ tons against 17¼ tons of the other. The blades are carried up free of the boss as shown, so as to allow of a free passage to the water in front and around the boss to the space beyond it, in order to prevent as far as possible the formation of any vacuity there.

In Fig. 7 a blade is shown on its flat with a section of the boss, and the mode of fastening the blades. Fig. 8 shows a blade in section cut circumferentially on a diameter of 6 ft. 8 in. Fig. 9 shows the propeller also cut to this diameter and the spiral passage which would be made by the blades through the water on this diameter in one revolution, the slip being 10 per cent as in the other propeller. The displacement caused by the blades and the slip is shown on the same scale, so that comparison can be made with the other propeller. I stated in the beginning of this paper what I considered were the chief defects of propellers as now made. The propeller before you is a practical attempt to reduce these defects, and it remains for the results of actual trial to show how far I have succeeded in my attempt.

† The velocity, or distance passed through the water each revolution by any point in the blade from the boss to the extremity, is simply stated by the formula

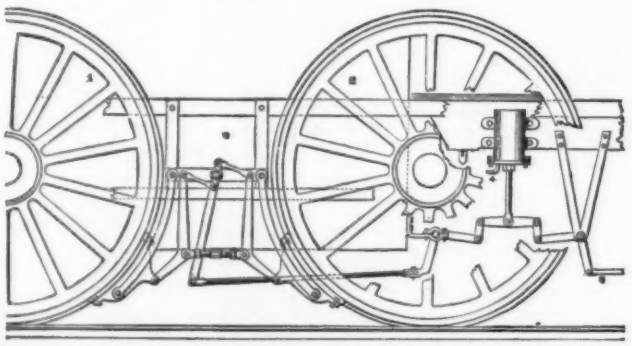
$\sqrt{(2\pi r)^2 + (P - S)^2} = D$. D being the distance passed through by the point each revolution, P the pitch of the propeller, and S the slip each revolution, or in other words, D is = the hypotenuse of a right angled triangle where the base is = the circumference of the circle of any diameter of the propeller, and the perpendicular is = the actual progress of the vessel each revolution of the propeller.

IMPROVED LOCOMOTIVE AND TENDER STEAM BRAKE.

THIS is the invention of Mr. John Hickey, the master mechanic of the Sheboygan and Fond du Lac Railroad, and has been in successful operation upon two engines of that road for the last six months. Its most prominent feature, as compared with other driver-brakes in use, consists in the employment of but one cylinder for the working of the entire apparatus, and the equal and simultaneous application of the retarding power to the engine drivers and tender wheels, the pressure of course being greatest on drivers.

The cylinder is located directly under the center of the foot-board behind the rear axle, and takes steam at the bottom by a short pipe (4) running from a three-way cock in the cab controlled by the engineer. The cross-head of the piston connects with an equalizer, and the ends of this with rock-shafts—the lower arm of the rocker under the driver axle being attached to a cross equalizer (not shown in side-view), from the ends of which, on either side, connecting rods extend to the lever-bars between the drivers as shown. The rod (5) attached to the arm of the rocker towards the tender, communicates with and applies the brakes to the wheels of the tender. The release is effected instantly by exhausting the steam in cylinder, the piston dropping by its own weight, and the brake-blocks receding from the face of the drivers by gravitation, the hangers being so arranged as to provide for this without the aid of springs.

The expanding levers between the wheels for setting the brakes, by means of the cross-equalizer which distributes the pressure equally on the wheels, readily adjust themselves by expansion and compression to every inequality of the track, allowing the engine, when the brakes are set, to have its proper movement on the springs the same as when the brakes are off.



HICKEY'S LOCOMOTIVE AND TENDER STEAM BRAKE FOR FREIGHT AND PASSENGER ENGINES.

LABOR-SAVING MACHINERY IN MASSACHUSETTS.

A FEATURE of the Massachusetts census of manufactures for 1875, deserving especial notice, is the showing made in regard to the effect of labor-saving machinery on the production of some of the leading staples. We find that, with 24,151 hands employed in 1865, there was produced 175,875,000 yards of goods, a ratio of 7,355 yards to each employee. In 1875 there was produced 874,780,000 yards by 60,176 employees, or about 11,213 yards to each hand. This shows that with an increase of a little over 149 per cent. during the ten years, in the number of hands employed, the quantity of cloth produced was increased nearly 392 per cent. Woolen goods also make a very striking exhibit. For 1865 the production is placed at 46,008,141 yards, and the number of employees 18,753. For 1875 the production is 90,208,280 yards and 19,036 employees, showing an increase of 96¼ per cent. in production to 1½ per cent. in the number of employees. The number of pairs of boots and shoes made in 1865 was 31,870,581, and number of employees 52,821, and in 1875, 59,762,866 pairs with 48,090 employees.

This is probably the most important showing made, the production during the ten years having been increased nearly 88 per cent., while the force employed was less by 4.731. The product of carpetings in 1875 increased fourfold as compared with 1865, while the increase of force employed was less than half that amount. The average value of the boots and shoes produced in 1845 was 70 cents a pair in 1855, 80 cents; in 1865, $1.80; and 1875, 1.50. The value of carpetings was $3 per yard in 1865, and less than 73 cents per yard in 1875—which shows the source of the immense supply of dollar carpetings.

PIPES FOR GAS AND OTHER PURPOSES.

THE valve of Messrs. Westwood and Wrights, exhibited in Figs. 36. 37 and 38, deserves to be better known than it is. It occupies less space than the generality of valves. From its peculiar construction, every part can be turned in the lathe, and, consequently, great accuracy is ensured in the fitting. No corrosion can take place on the faces, as they are always in close contact with each other, and it can be readily opened and closed by a key, an indicator showing the extent to which it is open or shut. One of its chief merits, especially when used on the gas works, is that it has no slot or recess at the bottom to fill with crystals and other solid matters, which prevent the closing of the slide. This has been specially designed for Beale's exhausters, but it is equally well adapted for other connections, to suit which it is made with a spigot at base. The several joints are faced to ensure close and tight fitting.

Messrs. Brown and May's sluice valve is shown in Figs. 44 and 45. The sluice or slide is moved by a bevel pinion working into a toothed rack cast in its back, and is kept in close contact with the face by pressure against two inclined planes. The construction of this valve is such, that by disconnecting one joint, which is planed, and held together by bolts and nuts, the whole working parts of the interior are exposed, and can be readily removed without interfering with the pipe joints. The valve is efficient and durable, and occupies as little space as any in use.—*Engineer.*

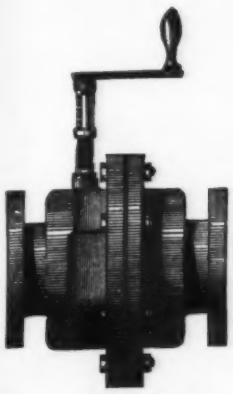


FIG. 36.

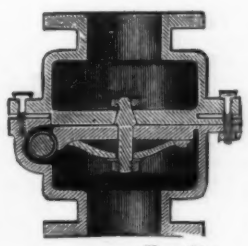
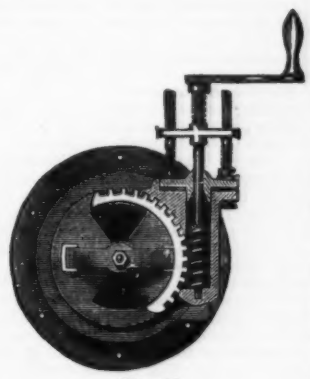


FIG. 37.



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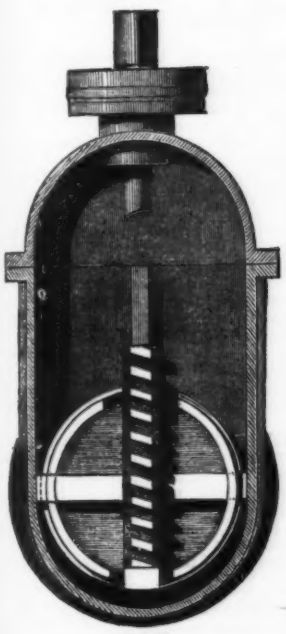

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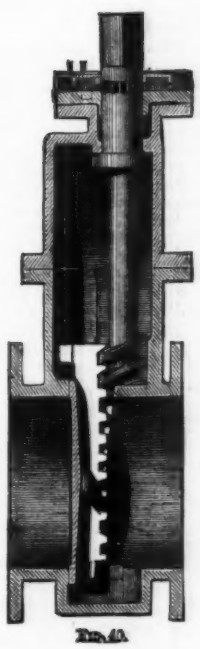


FIG. 40.

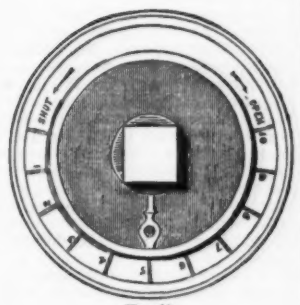


FIG. 42.

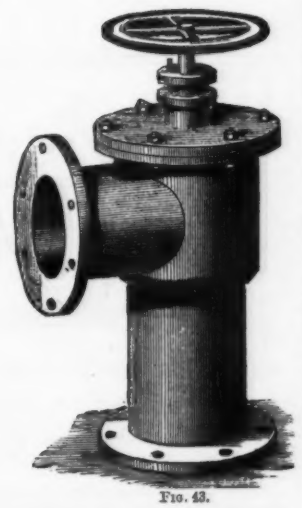


FIG. 43.

FIG. 44.

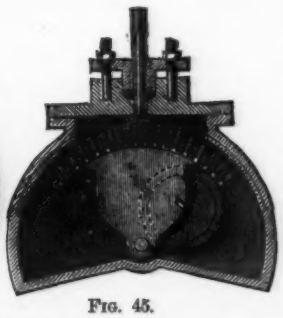


FIG. 45.

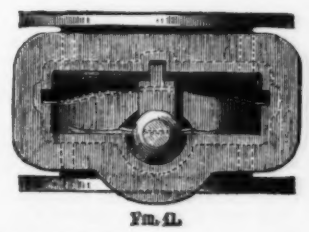


FIG. 41.

PIPES FOR GAS AND OTHER PURPOSES.

Its construction will be readily understood from the engravings.

In addition to all the usual forms of screw, and rack, and pinion valves, Messrs. George Waller & Co. manufacture two others, of special construction. These are shown in the annexed views. Figs. 39, 40 and 41 exhibit their improved index gas valve, the door of which has a circular wedged back, the firm being the first to manufacture this kind of door. The springs are used to clear off any dirt from the face when closing. The valve is operated by a spindle and worm working in the rack upon the door. The latter cannot possibly close by its own weight as is the case with the ordinary rack-valve when placed vertically, the worm keeping it at any required point. The index on the top, enlarged in Fig. 42, has studs to show the extent to which the valve is open, and they can be readily felt in the dark. The body of the valve is cast in one piece. Their disc-valve is exhibited in Fig. 43.

BRONZE CASTING.

IT is a most singular fact that melted gold, silver, copper and iron, if poured hot into a mould, will take the impression that retains on cooling all the details of the pattern from which the mould was made, only when the mould is made of sand. Zinc can be moulded in copper moulds, and that is the principal cause of the low price of spelter or zinc statuettes, known in the trade as imitation or French bronze. The real bronze is an alloy of copper, zinc and tin, the two latter metals forming a very small part of the combination, the object of which is the production of a metal harder than the pure copper would be, and, consequently, more capable of standing the action of time, and also less brittle and soft than zinc alone would be.

The original statuette is generally finished in plaster. The manufacturer's first operation is to have it cut in such pieces as will best suit the moulder, the mounter and the chaser, for very few bronze statuettes are cast all in one piece. Arms and legs are generally put on after the body is finished. The next operation is to reproduce the different parts of the figure in metal. For this the moulder takes it in hand to prepare the mould. He begins by selecting a rectangular iron frame, technically termed a flask, large enough for the figure to lie in easily. To this frame, which is from two to six inches deep, another similar frame can be fastened by bolts and eyes arranged on the outside of it so that several of these frames superposed form a sort of box. The workman places the plaster statuette, which is now his "pattern," on a bed of moulding sand inside the first iron frame. The sand used for mould-making is of a peculiar nature, its principal quality being due to the presence of magnesia. Only in one locality in the world is found the best sand, that is at Fontenay-aux-Roses, a few miles from Paris in France. This sand, when slightly damp, sticks together very easily, and is well fitted to take the impression of the pattern.

Once the pattern embedded in the sand, the workman takes a small lump of sand, which he presses against the side of the figure, covering a certain portion of it. Next to this piece he presses another, using a small wooden mallet to insure the perfect adhesion of the sand to the pattern. Each one of these pieces of sand is trimmed off, and a light layer of potato flour dusted both over the pattern and the different parts of the mould, to prevent them from adhering together. In course of time the entire part of the pattern left above the first bed of sand on which it has been placed will be covered with these pieces of sand, which are beaten hard enough to keep together. Loose sand is now thrown over this elementary brickwork of sand, if it may be so called, and a second iron frame bolted to the first one to hold the sand together, which, when beaten down, will form a case holding the elementary sand pieces of the mould in place. The workman now turns his mould over, and removes the loose sand which formed the original bed of the pattern, and replaces it by beaten pieces, just as he has done on the upper side.

We can now easily conceive that if the mould is opened, the plaster pattern can be removed, and that if all the pieces of sand were replaced as they were, we shall have a hollow space inside the mould which will be exactly the space previously occupied by the pattern. If we pour melted metal into this space, it will fill it exactly, and, consequently, when solidified by cooling, reproduce exactly the plaster pattern. For small pieces this will answer very well; but large pieces must be hollow. If they were cast solid, the metal in cooling would contract, and the surface would present cracks and holes difficult to fill. To make a casting hollow, it is necessary to suspend inside the mould an inner mould or "core," leaving between it and the inner surface of the first mould a regular space, which is that which will be filled by the metal when it is poured in. This core is made of sand, and suspended in the mould by cross wires or iron rods, according to the importance of the piece. A method often used in preparing a mould named by the French *cire perdue*, will help to illustrate this. The artist first makes a rough clay image of the figure he wants to produce. This will be the core of the mould; he covers it with a coating of modelling-wax of equal thickness, and on this wax he finishes the modelling of his figure. The moulder now makes his sand-mould over the wax; and when it is completed by baking the mould in a suitable furnace, the wax runs out, leaving exactly the space to be filled up by the metal. The celebrated statue of Perseus, by Benvenuto Cellini, was cast in this way, and it is very frequently employed by the Japanese and Chinese. Sometimes flowers, animals or baskets are embedded in the mould; and after the baking, the ashes to which they have been reduced are either washed or blown out to make room for the metal. This can easily be done through the jets or passages left for the metal to enter the mould, and through the vent holes provided for the escape of air and gases.

When the mould has cooled, it is broken to remove the casting it contains; and here is the reason why real bronze is so much more expensive than the spelter imitation. For each bronze a new sand-model must be made, while the zinc or spelter can be poured in metal moulds which will last forever. In this way the pieces are produced with but little more labor than that required to manufacture lead bullets. These pieces, of course, do not require the same expensive finish as the real bronzes. When the casting is taken out of the mould it goes to the mounter, who trims it off, files the base true, prepares the sockets which are to receive the arms or other pieces to be mounted, and hands the piece to the chaser. The work of this artisan consists in removing from the surface of the metal such inequalities as the sand-mould may have left, and in finishing the surface of the metal as best suits the piece. The amount of work a skillful chaser can lay out on a piece is unlimited. In some cases the very texture of the skin is reproduced on the surface of the metal. This mode of chasing, called in French *ciselé*, and in English "skin-finish," is, of course, only found on work of the best class. Sometimes pieces are finished with slight cross touches similar to the cross-hatching of engraving. This style of finish, which is much esteemed by connoisseurs, is named "cross-riffled" or *ribouté*. After the chaser has finished his work, the piece returns to the mounter, who definitively secures the elements of the piece in their places.

The next process is that of bronzing. The color known as "bronze" is that which a piece of that metal would take through the natural process of atmospherical oxidizement, if it were exposed to a dry atmospere at an even temperature. But the manufacturer, not being able to wait for the slow action of nature, calls chemistry to his aid, and by different processes produces on the surface of the piece a metallic oxide of copper which, according to taste or fashion, varies from black to red, which are the two extreme colors of copper oxide. The discovery of old bronzes, buried for centuries in damp earth and covered with verdigris, suggested the color known as *vert antique*, which is easily produced on new metal by the action of acetic or sulphuric acid. In the fifteenth century the Florentine artisans produced a beautiful color on their bronzes by smoking them over a fire of greasy rags and straw. This color, which is very like that of mahogany, is still known as Florentine or smoked bronze. Bronze can also be plated with gold and silver, nickel and platinum, like every other metal.—*New York Tribune.*

VARNISH.

By ZINGLER.

A MIXTURE of 1 pt. of carbon disulphide, 1 pt. of camphene or turpentine, 1 pt. of benzine or rectified petroleum, and 2 pts. of wood spirit, are heated in a close vessel, and powdered copal or other resin added to the solvent in the proportion of 106: 125 per 50 kilos. of resin. The mixture is allowed to stand for some days, and then a fatty oil is added.—*Chem. Centr.*

SEPARATION OF MIDDLINGS BY AIR CURRENTS, ETC.

THE hand sieve was originally employed for this purpose, the workman who performed this operation receiving the best wages in the mill.

Another ancient apparatus for this purpose was the Lanturelu. This simple contrivance consists of three sets of wheel blades; the arms or blades are fixed at a suitable angle, the whole are placed horizontally on a vertical spindle at certain distances from each other. The blades of the upper and lower wheels are set at the same angle, and revolve in the same direction, while the center wheel, having its blades inclined in a reverse way, revolves in a contrary direction. We extract the following descriptive sketch of the Lanturelu from Rollet's work on Milling, published in Paris in 1847, and also referred to in the Roret Manuels, by H. Benoit, also published in Paris, 1846, as being used for the separation of the light branny red particles, etc., from the "gruaux" (semolina). Fig. 1 represents the Lanturelu suspended; Fig. 2 is a plan of the same which, in this instance, consists of nine arms or blades.

FIG. 1.

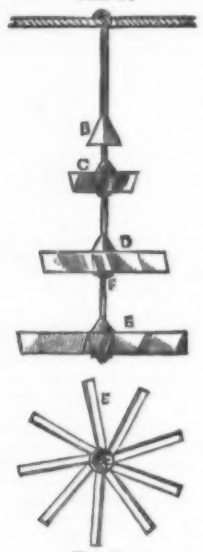
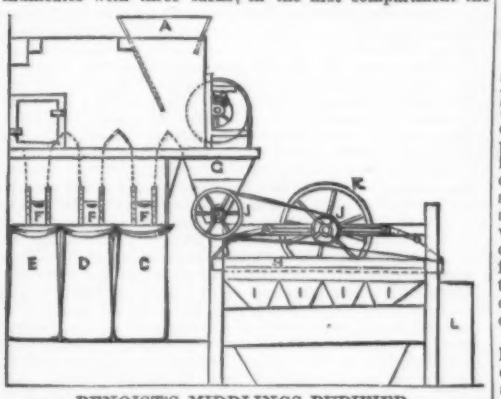


FIG. 2.

PLAN OF THE LANTURELU.

A.—In Fig. 1 is the hole through which the semolina is fed and falls upon the cone.
B.—The cone.
C.—First wheel blade, upon which the semolina descends, striking the inclined blades and thus turning them round.
D.—The center wheel blades, of increased diameter, having the blades set at an opposite angle.
E.—The third and last wheel blades, of increased diameter, having the blades inclining to an opposite direction to the second wheel.
F.—The shaft.

The height of this little apparatus is about 3 feet, and the diameter of the wheel blades about 20 inches. It will be seen that when the semolina falls through the hole, which is about 2½ inches in diameter, it turns the blades, which acquire a certain impetus and produce currents of air which greatly assist in the separation; the heavy semolina is deposited near the axis of the machine, while the light brans, etc., fall further from or nearer to the axis of rotation, forming circles, according to their respective gravities. The action exercised by currents of air, it appears, suggested the idea of the Lanturelu for the purpose of the separation of semolina or middlings. M. Rollet refers to a system of ventilation analogous to that employed for cleaning of wheat, and states that a carpenter named Pinet, employed by the celebrated Buguet, in 1775, invented the first ventilating semolina machines. N. Rollet also refers to a ventilating gruaux or semolina purifier, which he saw at work at the mills of M. Benoist, of St. Denis, near Paris. The sieve employed by M. Benoist receives the flour by a hopper, and in its fall the flour is traversed by a blast of air which forces all the light particles into three compartments. The latter communicates with three sacks; in the first compartment the



BENOIST'S MIDDLINGS PURIFIER.

Described by Rollet in 1847.

A.—Hopper.
B.—Fan.
C.—Sack for heaviest of brans, etc.
D.—Ditto for lighter.
E.—Ditto for lightest flocculent matter.
F F F.—Spouts.
G.—Hopper for heavy gruaux.
I I I I—Hoppers to receive the sized gruaux.
J J.—Pulleys.
K.—Fly wheel.
L.—Compartment for large gruaux which passes over sieve.

heaviest particles drop, in the second the lighter, and the lightest in the third. The gruaux, which has been too heavy to have been acted upon by the current of air, falls into a hopper, and thence to a perforated goatskin sieve, this skin has smaller holes at the head of the sieve, and larger at the lower end; a to and fro movement is imparted to the sieve, which facilitates the separation or sizing; the finest gruaux is sifted into the first hopper, and the inferior to the second, etc., etc., while the gruaux, which is too large, travels over the end of the sieve into a box. In the mill of M. Benoist two or three machines of this kind were placed one above another, cleaning the gruaux effectively, and resulting in a great saving as compared with hand sifting. The machine can be readily understood by reference to the following sketch.

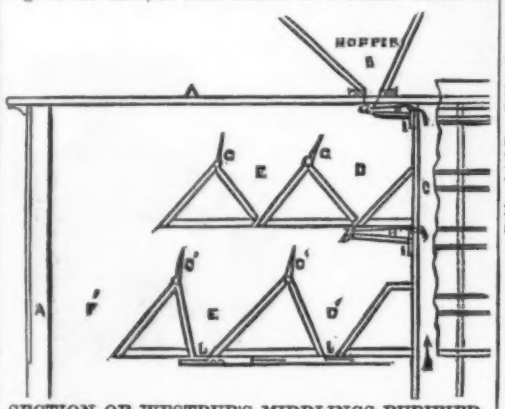
Walter Westrup, of Old Ford, obtained the following patent in England, dated 1st June, 1854.

A A is the casing or framing of the machine, and B is a hopper through which the grit is supplied to be operated on; D, E, F are three compartments with shifting boards, C C, between them, into which the grit falls from the hopper B; D', E', F' are three other compartments similar to those before mentioned, with shifting boards, C' C', into which the grit passes from the first mentioned compartments; G is the air canal, through which a blast of air is sent by any convenient blowing apparatus, such as a fan; H H are nozzles or apertures, through which the air enters the two tiers of compartments, D, E, F, and D', F', F'; these nozzles or apertures are fitted with slides, I I', by which their area of opening can be increased or diminished at pleasure. *l l* are slides to the compartments D' E', by which the grit can be retained in the machine or allowed to escape from it when required. The action of the machine is as follows: The grit falling from one of the hoppers, B, is met at *a* by the current of air entering through the nozzle, H, which acts upon the falling grit, and blows it according to its specific gravity, and the angle at which the shifting boards, C C, are set into the compartments, D, E, F, the lightest particles being driven into the farthest compartment, and so on. The grit then falls from the compartments, D', E', F', where it is met at *b* by a second blast of air, entering through the nozzle, H', which performs a second separating operation. The grit can be removed from the compartments, D' E', by the slides *l l*, and from the compartment, F', by a door in the side of the machine. The various qualities of grit obtained from the separating processes are re-ground, re-separated and re-cleaned, until no longer separable, as before directed, when they are ground into flour, which will be found to be of a very superior quality to that produced by the ordinary process of manufacture.

The next apparatus is that of M. Pierre Cabanes, of Bordeaux, for which machine that distinguished inventor took out an English patent, No. 2,612, dated Nov. 20, 1855. We extract the following from the complete specification:

This apparatus, which the inventor designates under the name of a mechanical sifter or bolter, is composed principally of a sieve suspended in a box, and possessing therewith two movements; viz., a horizontal and a vertical reciprocating movement. These two movements have for their object to separate the ground corn by shifting into two parts, one of which, the lightest, or particles of bran, rises to the surface, while the other and heavier portion, constituting the fine flour, passes through the meshes of the sieve, and is received into several vessels according to the fineness of the meal.

This novel system of bolting also embodies the important application of a floating cloth, which is adapted to the lower edge of the sieve, in such manner as to confine the air be-



SECTION OF WESTRUP'S MIDDLINGS PURIFIER.

tween the lower surface of the meshes and the bottom of the box. By this arrangement an upper current of air through the meshes is produced, which facilitates the desired separation between the particles composing the meal, by driving up the lighter portions.

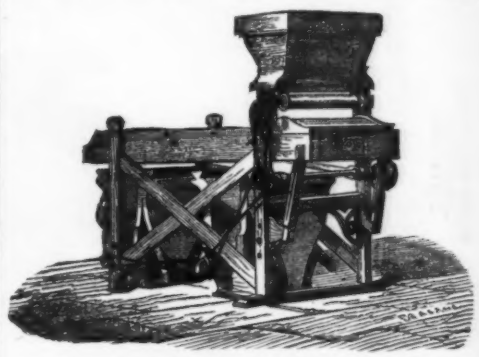
The apparatus is mounted upon cast iron standards, which are united by means of iron cross pieces. The two principal parts of the apparatus are the sieve and the box, upon the bottom of which falls the fine flour previously to its being discharged into receptacles. The bottom of the sieve is composed of woven wire cloth or its equivalent, and it is divided in the direction of its length into three parts; the meshes of each part having a different degree of fineness, which correspond respectively to the quality of flour intended to escape at the three openings made in the bottom of the box, through which the flour passes to the discharge chutes; two blowers or fans serve to complete the purification of the flour, by freeing it from any dust that it may still contain. The blower throws a blast of air into two pipes or channels simultaneously, which channels lead off from opposite sides of the fan case.

The sieve and box are suspended at the middle of their length from a shaft, having three eccentric portions turned down and forming crank necks; the two crank necks correspond in position and are concentric, but their position and, consequently, their action is diametrically opposed to that of the crank neck. The crank necks are embraced by iron collars or bearings, attached to the edges of the box, and the central crank neck is mounted in a collar or bearing affixed to the sieve.

On a rapid rotary motion being imparted to the shaft, the eccentric crank necks thereof will, by their peculiar arrangement, cause the sieve and box alternately to approach and recede from each other in a vertical direction. By the same cause, when the eccentrics have their centers in the same horizontal line, the box and sieve will be near as possible to each other, and will be displaced horizontally a distance equal to the distance between the line of centers of the eccentrics, a movement which is necessarily inverse and alternative.

In order that these two movements of the sieve and box may be perfectly parallel, or rather that the box and the sieve may preserve their parallellisms, they are connected with an arrangement of rocking levers, which have their fulcrums on the framing. These levers are connected respectively by means of links, the one end to the sieve and the other to the box. The pairs of rocking levers, of which there are three in number, are jointed through a pendent arm, with a wooden bar on each side of the machine. The result of this arrangement is that, whatever may be the movements of the sieve and box, they must always remain exactly parallel to each other throughout their whole length.

The above is surrounded at its lower edge by a band of linen cloth, which floats freely upon the bottom of the box. When the apparatus is at work, and the sieve and box are separated from each other by the action of the eccentrics, the band of cloth will scarcely touch the bottom of the box, and air will freely enter under the sieve; when, on the contrary, the sieve and box approach each other, the band will rest upon the bottom of the box, and the confined air will be forced through the meshes of the sieve. This result is one of the most favorable and indispensable for the bolting operation; the upward passage of the air driving the light parts of the meal up to the surface, and separating them from the flour,



CABANES' MIDDLINGS AND SEMOLINA PURIFIER.

which is by the above-mentioned movements caused to pass through the meshes of the sieve. The flour, when it has fallen to the bottom of the box, is traversed forward by means of the horizontal vibratory movement of the box to the discharge openings.

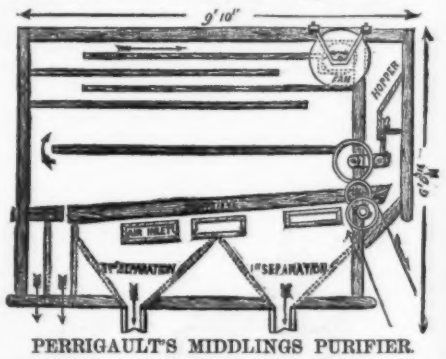
In the drawing, the sieve and its box are represented as being set at an inclination in the direction of the passage of the flour, but the machine might be made to work with those parts mounted horizontally.

The meal is fed to the bolter by a hopper, furnished with a roller. The driving shaft is furnished with a driving pulley and fly wheel, and motion is communicated therefrom to the fan. The guide roller, mounted inside the hopper, receives its motion from the same shaft through the pulleys. It will be understood that the flour will, according to its specific gravity, become separated into different qualities, as in the ordinary bolting operation. The refuse portion of the meal (or that which does not pass through either of the three gauges of mesh forming the bottom of the sieve) are moved forward by the reciprocating motion of the sieve to the further end thereof, whence they are discharged into any suitable receptacle.

In 1862, pamphlets and drawings were circulated in thousands to the principal millers of England, calling attention to the advantages of separating middlings by the system of M. Perrigault, an eminent French engineer.

M. Perrigault's apparatus is about 9 ft. 10 in. in length, 4 ft. wide, and 6 ft. 6 in. high. The fan is of peculiar construction, and runs vertically at a high speed.

We illustrate a cross section of this apparatus.



PERRIGAULT'S MIDDLINGS PURIFIER.

The action of the machine will be easily understood by the following description and the following sketch:

1st. The middlings, or semolina, is fed into the hopper, and distributed by a feed roll evenly upon the silk sieve, which latter has a longitudinal motion. During their fall upon the sieve the middlings are traversed by a current of air entering by an inlet immediately under the feed roll. The intensity of draught can be regulated by the miller.

2d. The sifting motion of the sieves causes the light particles to rise to the top; as the whole is cased in, the action of the fan is of considerable power. The air inlets under the sieve are so constructed that the intensity of the upward current can also be regulated by slides. It will be seen that the air is drawn incessantly through the meshes of the silk sieve, the object of which is to keep them open, and allow the heavier particles to fall into the lower hoppers (as shown). The sieves are clothed with two sheets of silk, one of closer mesh than the other, to suit the substance operated upon. The lighter, branny particles and flocculent matter are carried upwards by the current of air along the shelves, in the direction of the arrows, and deposited upon the former, according to their respective gravities. The lower slide or shelf is further apart than the others, consequently there is a larger deposit. The four upper shelves are closer together, and possibly retard or attract the floating atoms in their passage to the fan. These shelves are taken out to remove accumulations when required.

The heavier branny particles, coming against the corner of the lower shelf (see curved arrows), and the granular particles which are too large to go through the meshes of the silk, fall into their respective spouts at the end of the machine, as indicated by the arrows.

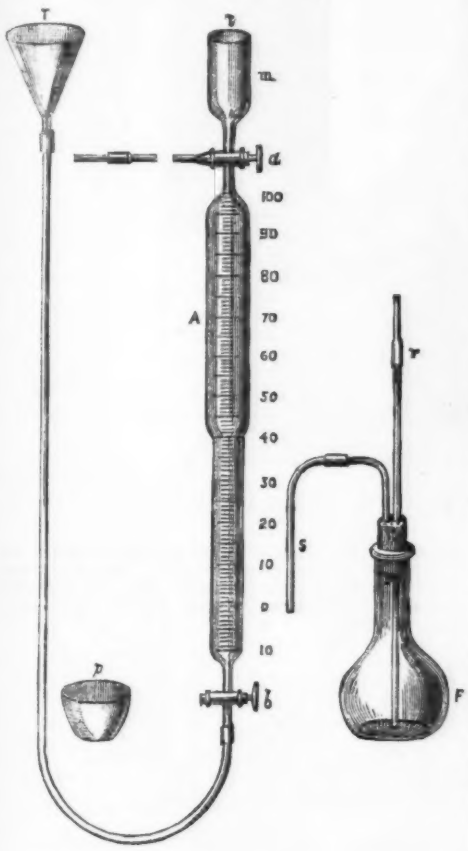
[JOURNAL FÜR GASBELEUCHTUNG.]

A SIMPLE GAS BURETTE.

By DR. H. BUNTE.

THE annexed sketch of a burette for the examination of mixtures of gas is in its general idea similar to an apparatus described by Raoult, but differs from the commonly employed apparatus of Winkler and Orsat, by allowing the reagents employed to absorb single constituents of the gas mixture to be quickly and thoroughly removed without loss of gas, so that almost any number of fluid absorbents may be employed successively on the same sample of gas. Moreover, the gas enclosed in the burette can be placed under equal conditions of pressure before and after each absorption by very simple means.

The gas burette, A, consists of a graduated gas-tube, closed above and below by cocks, *a* and *b*, and with a funnel-top, *t*. The space between the cocks *a* and *b* comprises rather over 110 c.c., and is graduated into cubic centimetres and fractions. The division marking 100 c.c. is at the point where the narrow tube, immediately under the cock *a*, widens; the zero point is a few centimetres above the cock *b*. The funnel, *t*, has a mark, *m*, and contains up to that point about 25 c.c. The lower cock, *b*, is a simple perforated stopcock; the construction of the upper cock, *a*, is similar to that in Winkler's apparatus. Besides the transverse aperture, there is also an axial bore entering at the side, and then running parallel with the axis of the cock, by means of which the interior of the burette or of the funnel can be put in communication with the outer atmosphere, or with an india-rubber tube, drawn over the end of cock *a*. As the burette is chiefly used for the examination of combustible gases, in which the non-absorbable portion amounts to at least 60 per cent., the lower part, on which the readings are made, is narrowed to allow of the divisions being wider. The burette is kept in an upright position by means of a spring clamp fastened to an iron stand.



To fill the burette with gas, an india-rubber tube, communicating with the gas pipe, is passed over the point of the cock *a*, by turning which the interior of the burette is put in communication with the tube through the axial bore. The cock *b* being also opened, gas is allowed to pass in till the air previously contained in the holder has been expelled by the gas, when both cocks *a* and *b* are closed. The end of the cock *a* is closed by a stopper or india-rubber cap, and the funnel filled up to the mark, *m*, with water.

To bring the enclosed volume of gas, which is an unknown pressure, to 100 c.c. and to a known pressure, water is forced, by means of another funnel, T, and an india-rubber tube, into the burette from below, up to the zero point, of course taking care that the tube is completely filled with water before it is put in communication with the holder. When, after closing *b*, the cock *a* is turned so as to place the holder in connection with the funnel, *t*, filled with water, a portion of the gas will escape in bubbles till the remainder rests under the pressure of the atmosphere, *plus* a water column of a few centimetres. The water in the funnel, *t*, is retained by capillary attraction in the connecting-tube and the bore of the cock, and stands over the gas enclosed in the burette, so that neither water can enter nor more gas escape. In this way the enclosed gas can always be brought to the same pressure (atmosphere *plus* a water column of a few centimetres); and in the ordinary notation of the results by percentage of the total volume a correction for the pressure, which is made equal before taking each reading, becomes unnecessary.

To carry out an absorbtio-metric analysis, room must be made for the absorptive agent within the burette. To effect this, a bottle, F, is connected with the lower end of the holder by its longer tube and the india-rubber tube, *r*, while the tube *s*, fastened to the shorter bent tube, is taken into the mouth, and the water nearly all sucked out of the burette; the cock *b* is then closed, and the bottle, F, removed. The absorbent is then poured into a china basin, *p*, and the lower point of the burette immersed below the surface. On opening the cock *b* the liquid absorbent is sucked in. The lower point of the burette is so narrow that capillary attraction keeps it constantly filled to its mouth with fluid, so that no air can enter into the holder during the manipulation.

When the cock *b* is closed, the burette must be laid horizontally, or, better still, well shaken, to promote absorption. The funnel-top must be taken hold of, the opening being closed by the palm of the hand, and the burette violently shaken lengthwise; any warmth from the hand coming in contact with the graduated tube is thus avoided.

To ensure complete absorption of the constituent portion of the gas by the reagent, after shaking as above, more of the absorbent is admitted, and this process repeated till the level of the fluid in the measuring-tube remains constant. Before reading off, the measuring-tube is connected, by turning the cock *a*, with the water in the funnel, *t*, when the water flows in till the former pressure is re-established; if needful, the funnel is filled up with water to the mark, *m*. The reading gives at once the percentage of the absorbed constituent that was contained in the gas under examination.

In the analysis of chimney-gas the reagent first applied is solution of caustic potash or soda. The diminution in volume denotes the portion of carbonic acid contained in the gas. To determine the oxygen, a portion of the alkali solution is sucked out, and a concentrated solution of pyrogallic acid introduced. Pyrogallate of potash is formed, and the presence of oxygen may be at once detected by its coloring the salt; the burette is shaken for some time, until, when the lower aperture is introduced into the absorbent mixture and the cock *b* opened, no more enters the tube; finally, water is admitted from the funnel, *t*, till the former pressure is re-established.

To determine the carbonic oxide, the absorbents hitherto employed must be completely removed. The case with which this operation can be accomplished makes this burette particularly convenient. The pyrogallate is sucked out by means of the bottle, F, to within a few drops; by opening the cock *a* a powerful jet of water is forced into the tube from the funnel, *t*, washing the sides completely. The cock *a* is then closed, and the cleansing water sucked out as before. By repeating this process a few times the absorbent is completely removed, and another can be introduced through the lower point of the burette.

In the case of an analysis of smoke-gas, hydrochloric acid or ammoniacal solution of chloride of copper is introduced into the tube, and manipulated as before. As these concentrated solutions readily yield hydrochloric acid or ammonia to the residue of gas, causing slight errors, it may be advisable to replace the absorbent by water, in the manner already described, before reading off.

The analysis of a complex gas mixture, such as the determination of some constituents of coal gas, according to Berthelot, which requires the successive action of several reagents, as sulphuric acid, bromine, nitric acid, &c., is easily carried out by means of this burette, with slight modifications in the manipulation.

The accuracy of the results so obtained, if the usual precautions are observed, is quite equal to that yielded by the apparatus ordinarily in use for technical gas analysis. Very minute accuracy, however, is of the less importance in the researches for which these apparatus and the gas burette now described are employed, as in many cases a merely qualitative gas analysis would be sufficient for the objects of the experimenter, if it were not that it would require just as much labor as a complete quantitative examination. The burette in question is also distinguished from others by the two cocks being constantly kept closed by fluid, so that loss of gas by leakage is hardly possible. How far the burette is available for analysis of non-absorbable gases, by means of combustion, has yet to be tried.

TANNIN EXTRACT FACTORY.

A NEW industry has recently been started at East Machias, Me., by a company formed for the purpose of extracting tannin from sweet fern, which grows wild and in abundance in that vicinity, the extract to be used in tanning light hides. The capital stock of the company is $20,000, while the new factory, which has been erected the past season, will cost some $16,000. Up to the present time $4,000 has been expended for sweet fern, scattering money among the poorer classes, who were sadly in want of work and money. The factory is all in readiness, and it is expected that operations will begin on the first of this month. The *Machias Union* has a notice of the works, from which the *Kennebec Journal* condenses the following:

The fern is housed in sheds winged off from the main building and easily moved when wanted to the hopper of the cutter. This is the first step—place the fern in a cutter, a machine something like a hay cutter. This cuts it quite fine. If worked to its capacity the machine will cut one and a half tons per hour.

Two tan-burners are constructed in the basement. The spent fern, woody, fibrous parts are accumulated here and used in the furnaces to heat the water and building. This waste material is expected to furnish all the fuel required after well in operation. The main shed for storage of fern is twenty-six feet wide, one hundred and thirty-five feet long, and fourteen feet high. Besides, there are three other sheds thirty feet wide, one hundred and ten feet long, and sixteen feet high.

From the cutter the chopped fern passes into elevator cups, thence it is raised to the fourth floor of the building. The cups are constructed quite like the cups in a grist or flour mill, whereby the meal is raised to the upper floors. On the fourth floor are four leaches, being tanks made round and holding ten thousand gallons each. The chopped fern is deposited in these leaches from the elevator cups. Near by are two reservoirs. When in operation these reservoirs are filled with hot water. They hold 3,250 gallons each. The hot water by means of a pump is sprinkled on to the fern in the leaches. This is the leaching process or second step in the extracting operation. The hot water and steam is all passed through brass pipes or tubes, no iron being used.

After steeping as long as necessary the liquor is passed from the leaches to four store tanks. These tanks hold about 2,700 gallons each. In these tanks, which are on the third floor, the liquor is allowed to settle. Next it is passed to three condensers on the second floor. The condensers are semi-circular in form, 7½ by 10 feet inside, and supplied with 200 feet of brass pipe each one. The second condenser is higher than the first, and the third higher than the second. An immense heat is forced into the liquor in the condensers by means of the pipes. A revolving shaft with discs twenty feet in diameter is kept constantly in motion, stirring and agitating the liquor. A cloud of steam and vapor is constantly arising, seeking escape through the ventilator at the top of the factory. This process is evaporation. When concluded only the pure or best tannin extract remains.

Great vigilance and superintendence are needed at the condensers. The extract must not be scorched or burned. A faithful superintendent is needed here. When the tannin is reduced to proper consistency, it is passed from the condensers into coolers. When cooled it is drawn off into barrels. The barrels hold forty eight to fifty gallons each, or about 500 pounds to the barrel. The extract is now ready for shipment. After the first few days' running the weaker liquor is returned to the leaches. This serves a better purpose in extracting juice from the fern than clear water. The weaker liquor is held in reserve after the stronger is withdrawn from the tanks, the former being kept in two junks of 3,200 gallons each; thence it is forced to the leaches. The exhausted steam from the boiler of the driving engine in the basement is forced to do different duties, some of it reaching the leaches on the fourth floor. The principle of "no waste" is strictly adhered to in all arrangements, position, and construction of machinery.

One engine of thirty horse-power is the principal motive power. An engine of seven horse-power is used to operate the condensers. The boilers are fed from the hot-water tanks. The combination of power equals eighty-five horse-power. Water is pumped from the river, a distance of 125 feet, through pipe two and one-half inches in diameter. In the basement are two furnaces, six feet by sixteen feet, four feet high, two feet thickness of brick bottom, sides and top; inside all fire-brick and in best possible manner.

The enterprise is a commendable one. Nearly all the capital is furnished by citizens of East Machias. Any profits ultimately, which we hope will be abundant, will be their gain. Already the results are felt for good. Cash paid for sweet fern, for labor, timber, and material has been a blessing to the community.

At no time since the inception of the movement have the friends and stockholders felt so well encouraged and so hopeful of remuneration as they do at this time. The evidence of demand for the tannin extract, also as to the supply of sweet fern, is increasing, convincing, and satisfactory. There is no establishment in the country like this, considered in its convenience, capacity, entirety, and completeness. The factory will probably consume fifteen tons per day of sweet fern.—*Boston Advertiser.*

ARTIFICIAL LAUREL WATER.

By A. RIPPING.

BY the differences which are observed in laurel waters brought into the market, the author was led to suppose that some artificial laurel waters exhibit the reactions usually regarded as characteristic of the natural water; moreover, as he succeeded in preparing an artificial laurel water, he endeavored to find out other tests by which water so prepared may be distinguished from the natural water.

In order to prepare the artificial water, it was, in the first place, requisite to estimate the quantity of oil in distilled laurel water. Half a liter was neutralized with pure potash lye, the mixture shaken up with ether, and, after evaporation of the ether at the ordinary temperature, the oil was dried in a desiccator for 48 hours and weighed. 3 g. of oil were obtained for 1 liter. In the next place, hydrocyanic acid was prepared. For this purpose an improved form of Fleischer's apparatus for determining ammonia was used. 50 parts of yellow prussiate of potash were brought into a flask of 3 c.cm. capacity, and 35 parts of concentrated sulphuric acid added, the flask being then connected with the rest of the apparatus. 15 g. of prussiate of potash yielded 10 c.cm. of hydrocyanic acid. After having made the strength of the acid the same as that of laurel water, 1 liter was treated with 3 g. of oil of bitter almonds. The artificial water was found to correspond with the ordinary reactions for natural water, its composition being the same as that of natural laurel water after the lapse of about eight weeks. 10 c.cm. required 5 c.cm. of normal silver solution. Mixed with ¼ vol. of ammonia, it formed a distinct opalescence after 10 minutes, and became quite non-transparent after 20 minutes.

Mohr gives a reaction for distinguishing artificial and natural water of bitter almonds, depending on the fact that nitrate of silver yields a slight opalescence with the natural water, and, after further addition of nitric acid and ammonia, a copious precipitate. The author has also observed a difference in the behavior of artificial and natural laurel water with nitrate of silver. In natural distilled water the hydrocyanic acid is totally fixed as benzaldehyde, the turbidity being due to the presence of cyanide of ammonium formed during the distillation, aqueous prussic acid yielding formic acid and ammonia when warmed. One part of the latter yields, with the hydride of benzyl, benzhydramide, while another part yields cyanide of ammonium. However, it had to be determined whether by a second distillation, or by some other means, artificial laurel water could yield a compound consisting of benzaldehyde and hydrocyanic acid. The following accounts are given: (1.) Distillation yields a liquid which soon turns brown and becomes unfit for use. (2.) By distilling with prussiate of potash, sulphuric acid, and oil of bitter almonds, a distillate is obtained, which is almost free from benzaldehyde. The acid used must be diluted with twice its own weight of water, otherwise the distillate will be adulterated with hydroferrocyanic acid. (3.) 1·5 g. of oil of bitter almonds was mixed with ¼ liter of distilled water, 14 g. of cyanide of potassium added, and the mixture treated with 6 g. of previously diluted sulphuric acid. The quantity of acid was calculated accurately for forming the neutral sulphate. Although the distillation commenced on a water-bath, the oil being dissolved in the water, and every molecule of hydrocyanic acid being enabled to act on the benzaldehyde as quickly as it was formed, no compound could be obtained, the distillate consisting exclusively of dilute hydrocyanic acid, so that in this case also the oil was retained by the sulphuric acid. (4.) 6 g. of oil of bitter almonds were mixed with ¼ liter of distilled water, the mixture placed in a tubulated retort, and treated with 4·5 g. of cyanide of potassium. Carbonic acid gas was then introduced, which resulted in the decomposition of the cyanide of potassium, hydrocyanic acid being the product formed. The result was quite different from the former, benzaldehyde distilling over, combined with hydrocyanic acid, leaving bicarbonate of potassium and benzoin in the retort. The smell of the water obtained was, however, very different from that of aqua laurocerasi. Another experiment was undertaken with real laurel oil, and the process conducted similarly to the former, excepting that the distillation was carried on over a gas flame, and the retort connected with a Liebig's condenser. In this case an artificial laurel water was obtained, which corresponded with the natural water in all its properties. It was perfectly free

from formic acid, and contained a larger or smaller quantity of cyanide of ammonium.

The oils used for the preparation of artificial water are easily distinguished from one another. Oil of bitter almonds gives crystals when placed on a watch-glass covered with a bell-jar, and left at rest for 14 days, while laurocerasus oil does not give the slightest indications of crystals. Nitrobenzene is recognized by the following test: The water is shaken up with chloroform, the latter evaporated off, the residue treated with alcohol and water and exposed to the action of zinc and hydrochloric acid. If after the addition of chlorate of potassium a change of color is obtained, nitrobenzene is present, the aniline formed by treatment with zinc and hydrochloric acid being converted by the chlorate of potassium into rosaniline, which dissolves in the alcoholic liquid with a red color.—*Arch. Pharm.*

SOLUBLE GLASS.

A CORRESPONDENT, referring to the article on the chemistry of glass in the last number of the *Journal*, expresses his regret that further information was not given concerning "soluble glass." As we remarked at the close of the article, w had by no means exhausted the subject, and this branch foet was one that we intended to take up at another time.

The silicates of soda and potash differ from the other silicates grouped under the general name of glass in being soluble in water; hence they are known as soluble glass, water-glass, liquid quartz, etc. While ordinary glass has been known from very ancient times, these peculiar compounds are quite new to us, having been accidentally discovered by the late Professor Fuchs, of Munich, in the year 1818, while experimenting with a view to the preparation of pure silica. In 1823, when the Munich theater was rebuilding after its destruction by fire, the Bavarian government appointed a scientific commission to consider by what means the woodwork and stage fixtures might be rendered incombustible; and Fuchs, in connection with Pettenkofer, after careful investigation, settled upon soluble glass as the best agent for the purpose. It has since been much used in this way, though for textile fabrics the tungstate of soda has come to be preferred. In applying soluble glass it is necessary to begin with a weak solution, and to let the first coat dry thoroughly before putting on a second, which may be more concentrated. A wash of lime is sometimes used between the two coats.

When the soluble glass is applied to surfaces of plaster and limestone, an interesting chemical reaction takes place, resulting in the formation of silicate of lime. A vitreous surface is thus produced, impervious to moisture and unaffected by atmospheric agents. Soluble glass is also used as a vehicle for mineral colors in a kind of fresco painting, known as *stereochromy*, which is intended to withstand exposure to the weather. The famous frescoes by Kaulbach in the Museum at Berlin were done in this way. It is also coming to be employed for preparing paints for ordinary use, and there are factories exclusively devoted to the manufacture of this class of pigments.

One method of making artificial stone is by moistening fine sand with a solution of silicate of soda, pressing the mixture into moulds, drying it, and exposing it to a high temperature. The silicate fuses and cements the grains of sand together into a mass resembling sandstone. Any desired color may be imparted to the stone by the admixture of metallic oxides previous to the moulding process. Thousands of tons of the silicate are consumed for this purpose in England.

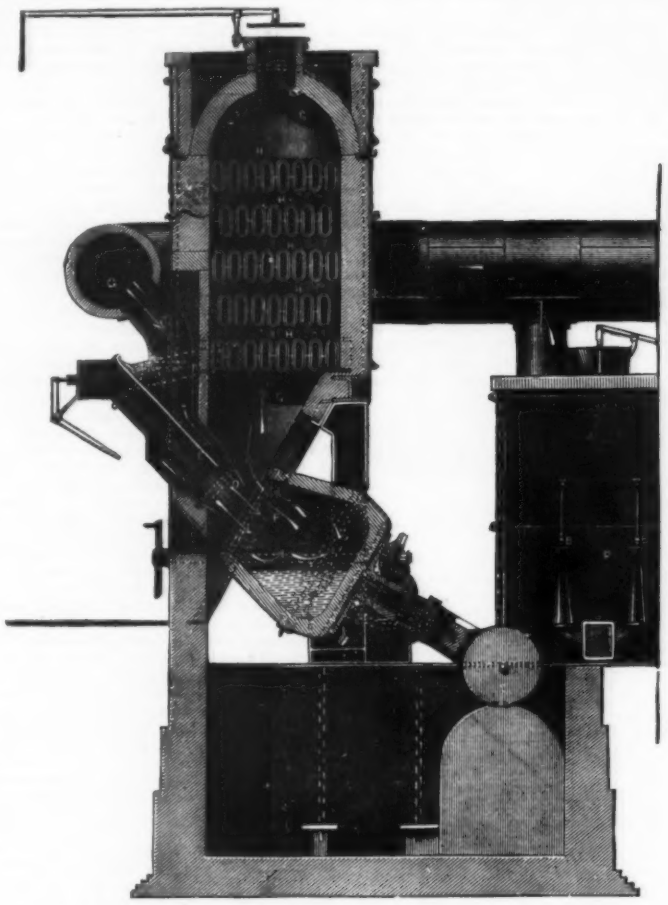
Another important application of soluble glass is in calico printing, where it is now extensively used as a mordant. It is even more in demand in soap making, for which it has advantages over resin, on account of its alkaline character. It also enters into the composition of fire-proof cements for stoves and other iron work, and especially for putting up iron fronts for buildings.

In this brief notice we have mentioned only the leading uses of this valuable substance. The demand for it in the arts is daily increasing, and it is probable that its commercial and industrial applications are destined to be immensely extended in the future.—*Boston Journal of Chemistry.*

IMPROVEMENT IN REVOLVING FURNACES.

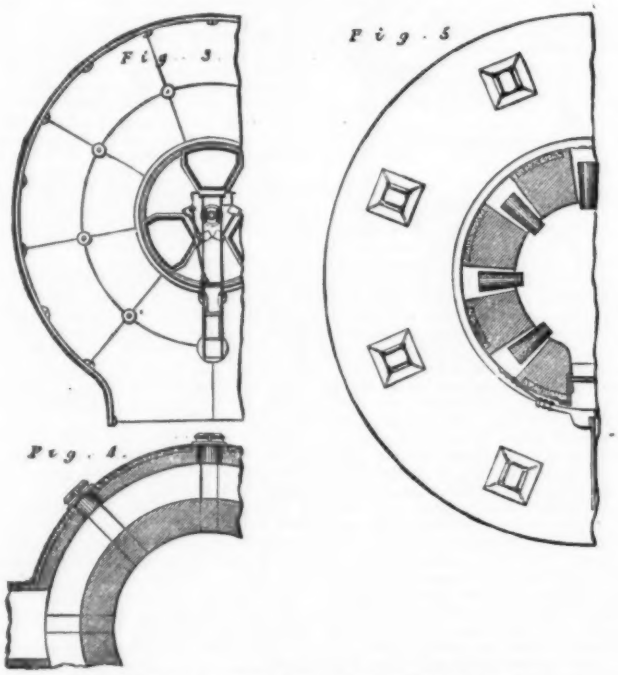
WE illustrate improvements in revolving furnaces by Messrs. Godfrey and Howson, of Middlesbrough, Eng., which formed the subject of the paper read by Mr. Howson at the recent meeting of the Iron and Steel Institution, and which are regarded by many iron-workers as the most important advances in the process of mechanical puddling since the introduction of the Danks' furnace. Mr. I. L. Bell will employ this furnace in his experiments with Cleveland ores. According to the present invention, they use a steam-jet for producing the requisite pressure so that the gas-holder may be dispensed with. The jet may be of the ordinary well-known construction, but its position must be such that the injected steam mixed with air must pass through the incandescent mass of coals or other fuel with which the retort or generator is supplied. By this arrangement the steam becomes decomposed, as is well understood, while at the same time a pressure is set up in the retort or generator, thereby propelling the gas and causing it to issue with the requisite degree of force at the burner. Referring to the drawing, A is the retort or gas generator, consisting of a chamber or oven containing coal or other fuel. The exact form or type of such oven is not material, but the air which is supplied to it for partial combustion and production of gas is forced in among the mass of incandescent fuel by means of the steam jets, B B. In this manner, while the steam becomes decomposed, a pressure is set up in the interior, and the gas is forced in the direction of the arrows along the main, C, issuing ultimately at the burner, D, where it meets with a blast of air from the nozzle, E. In the illustration the burner or tuyere is shown at D, as if it were a solid casting or forging, either of which it may be when the heat of the furnace is not required to be very great, but in cases in which a high temperature is required the tuyeres are protected by an internal circulation of steam instead of water in order to avoid the danger of explosion in case a leak should occur from any cause in the burner or tuyere. It is a leading feature of the former invention that the edge or lip of the revolving vessel (marked F in the drawing) is entirely free from contact with any rubbing surface, and that the waste gases are allowed to issue between the outside of the burner, D, and the inside periphery of the vessel, F. The necessity for a chimney in the ordinary sense is thus dispensed with. The patentees now allow the waste gases to issue in precisely the same manner, but according to the present invention they are afterwards made to take a direction upwards through an opening into a chamber which is traversed by a series of heating-pipes before escaping into the atmosphere. G is the heating-chamber (shown in vertical cross section), containing several rows, H, of heating-pipes through which the air required for combustion at the burner, D, is forced by mechanical means, thus traversing the successive rows of hot pipes until it issues and meets the gas at the nozzle, E, at a comparatively high temperature.

Only one form of furnace described in the previous patent is shown in the drawing—namely, that which is mounted on trunnions and revolves at an angle. The improvements are equally applicable to the arrangement by which the furnace revolves horizontally, whether such horizontal furnace is supplied with two burners—that is to say, one at each end—or whether there is a burner only at one end, and the burnt gases are allowed to issue at the other end; in every case the improvements are consistent with that distinctive feature of the former patent, namely, that the end or ends of the furnace revolve without frictional contact with any opposed surface.



IMPROVEMENT IN REVOLVING FURNACES.

proportion of cement to oxide may vary; one of the former to three of the latter answers the purpose. The patentees also say that they have ascertained that their revolving furnaces are applicable to other useful purposes; for instance, to the manufacture of soda-ash and other chemicals, to the roasting of ore, and other purposes where an intimate mixture of materials while in a heated state is a desideratum. Revolving furnaces are generally applicable as auxiliaries to the Bessemer process, and it is well known that in the process only pig iron of a certain degree of purity can be employed; but the patentees use the revolving furnace for refining or purifying pig iron of a commoner and cheaper class, and the iron so refined or purified—that is to say, either puddled or partially puddled—is added to the ordinary charge of the Bessemer converter, incorporating the same with it, by which means it is impossible to a certain extent to economize the consumption of more expensive brands of pig iron.—*English Mechanic.*



ANTHRACITE BLAST FURNACE.

In the formation of the lining of revolving furnaces it is usual to employ oxide of iron. It is a feature of the present invention that oxide of iron is used in combination with Portland or other hydraulic cement. A part of the oxide is ground or used in the state of powder, and it is worked up with water and a small proportion of hydraulic cement to the consistency of mortar. The interior of the furnace is plastered with this material, and while it is in a plastic state lumps of oxide are imbedded in it. The whole becomes shortly set into a hard mass, and is then ready for use. The

ANTHRACITE BLAST FURNACE.

WE illustrate an anthracite blast furnace, designed at the Weimer Machine Works of Lebanon, Pa., and presenting in its construction several new features of interest. Mr. Weimer, the designer, has endeavored to embody in this construction a complete arrangement to fulfill the requirements of the special fuel used.

It will be noticed that the entire stack from the hearth to the head is encased in a sheet iron jacket, the shield below

the tuyere openings being secured to the dam-plate and bosh casing with bolts, so as to be readily detached.

The usual cast iron columns and mantle are dispensed with, and strong wrought iron columns extending up to the bosh are substituted. These columns are composed of 18-in. I beams, and 1 in. plates 18 in. wide, riveted together, and supporting an angle-ring casting to which they are riveted by suitable projections. The columns each rest upon, and are secured to, square breastplates, which are tied together by three bolts (1 in. in diameter) so as to prevent any spread of the bases owing to expansion of the hearth.

Further experiments were made, and proved that copper lining lasted longer than any other; and at present their furnaces are lined, about two feet high above the tuyere, with copper plates 1¼ inches in thickness by 24 inches in height. The ore they smelt is carbonates and oxides, yields 25 per cent., and the per cent. of matt obtained is about 90 per cent. The furnaces have a capacity of 12 tons per day, and use charcoal for fuel.

Mr. Magruder gives a most flattering account of the silver mines of Colorado, and especially of the mines under his charge.—*Engineer of the Pacific.*

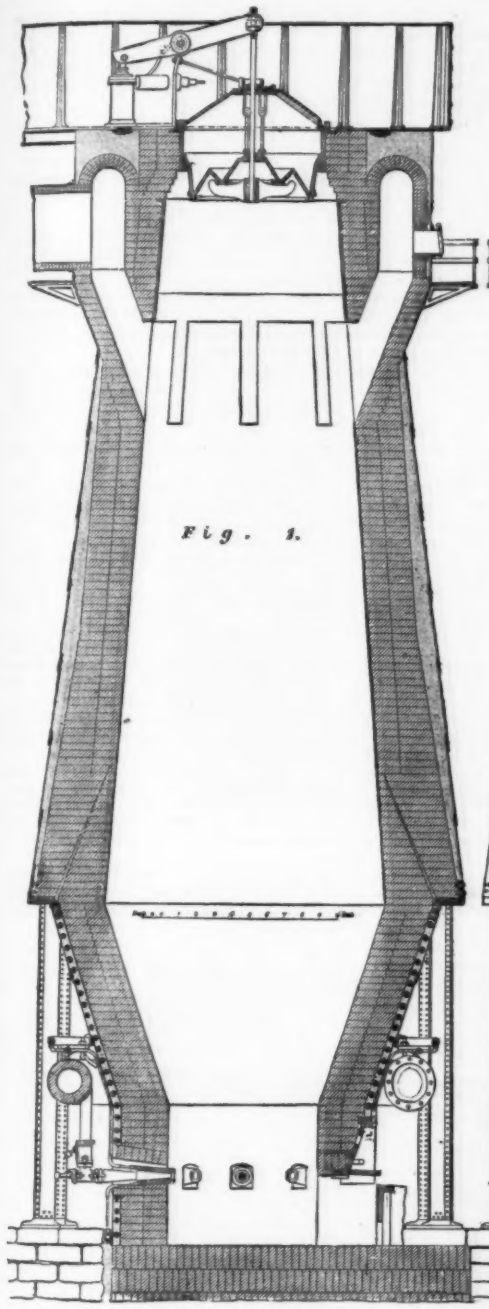


Fig. 1.

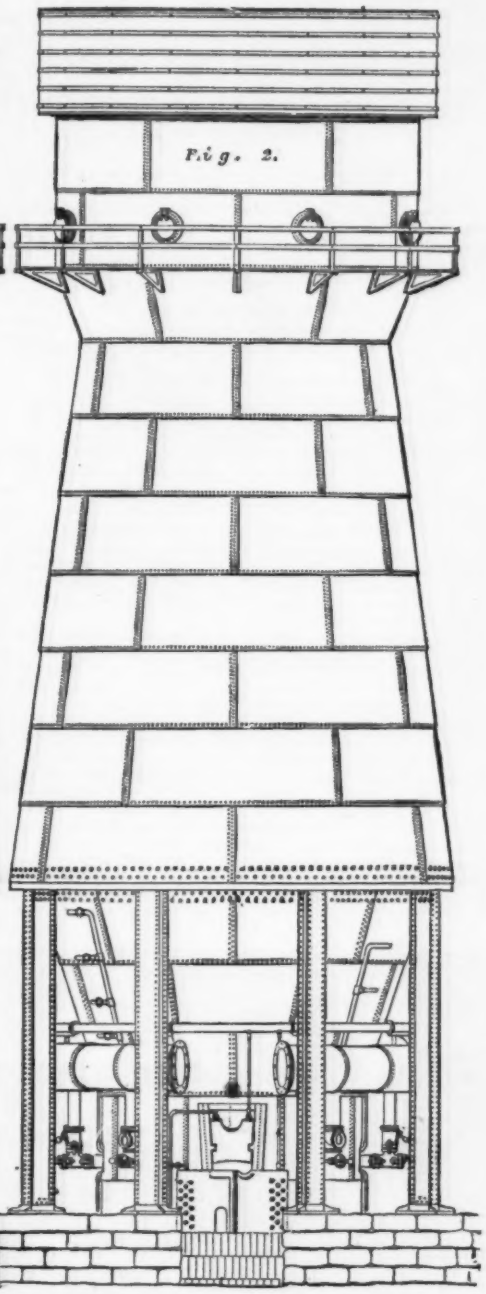


Fig. 2.

ANTHRACITE BLAST FURNACE. DESIGNED AT THE WEIMER WORKS, LEBANON, PA.,

The angle-ring, which takes the place of a mantle, has riveted to its upper part the shaft casing, and to its lower part the bosh casing, thus insuring increased strength.

The walls of the hearth and bosh are 30 in. thick, and made of firebrick, with a loam space of 4 in. between the walls and the casing. In the loam placed in this space a series of cells of 3-in. pipe is imbedded, through which water circulates. These pipes are not continuous, but comprise a series of coils, each supplied from a main pipe, and controlled by valves, so that each may be used independently if occasion should require. Thus any portion of the bosh or crucible can be subjected to the cooling effect of these pipes.

The circular blast pipe and the water-supply pipe for tuyeres and casing are supported upon brackets attached to the columns. The top of the furnace is shown fitted with an annular bell, depositing about one third of the charge in the center of the furnace, the remainder being thrown against the sides. It is covered with Weimer's furnace charger, which prevents the escape of gases when the bell is dropped. The illustration shows a furnace stack measuring 17 ft. across the bosh, and 62 ft. in height, from floor of hearth to top.—*Engineering.*

COPPER LINING FOR FURNACES.

ON our late journey through Arizona, we had the pleasure of meeting Mr. J. R. Magruder, of Colorado, who told us, among many other interesting features of that State, that they now line their copper furnaces with copper plates, in place of clay or firebricks.

A Mr. Cornelius Bennett is credited for the accidental discovery, in the following manner: The lining of a furnace, while in active blast, gave out and caused a side hole in the furnace; he tried to stop it with all the material on hand, but failed, and the last and nearest material on hand was a slab of copper, which he sat up against the hole, and there it remained, to his astonishment, untouched by the fire.

THE FORMATION OF COMPOUNDS AT A TEMPERATURE CONSIDERABLY ABOVE THAT OF THEIR DECOMPOSITION.

By TROOST and HAUTEFEUILLE.

1. SILICON sesquichloride, Si_2Cl_6, decomposes at 350°, and its decomposition is complete at 800°, thus: $2Si_2Cl_6 = 3SiCl_4 + Si$. But at 1,200° the reaction is this: $3SiCl_4 + Si = 2Si_2Cl_6$. If the tube in which the sesquichloride is kept at 1,400° be suddenly cooled, the sesquichloride condenses as such; if slowly cooled, it has time to decompose, and tetrachloride and silicon are the only products. Ditte has proved that this is also the case with selenide and telluride.

2. If a porcelain tube containing metallic platinum, and provided with a glass tube in its interior, through which a current of cold water passes, be heated to 1,400°, the platinum is converted into tetrachloride, $PtCl_4$, which condenses on the cold glass tube. But at a lower temperature, the tetrachloride is decomposed.

3. Ozone is converted into oxygen at 250°. But at 1,300—1,400°, a silver tube kept cool by water, placed in the interior of a porcelain tube filled with oxygen, was covered with a layer of dioxide; this is the effect of ozone. It is possible, by drawing off the gas from the interior of the porcelain tube, and quickly cooling it, to prove the formation of ozone by the decolorization of indigo and other reactions. At a lower temperature, however, no ozone is formed.

4. If silver be vaporized to 1,400° in a porcelain tube, through which a tube cooled with water passes, in presence of oxygen, metallic silver, mixed with a very large proportion of protoxide, condenses on the cold tube. But if the porcelain tube be allowed to cool, no protoxide is formed, as it is all decomposed at a temperature below 1,400°.

It is therefore not correct to assume that a substance which undergoes dissociation at a low temperature cannot exist at a higher temperature.—*Compt. Rend.*

PERMEATION OF PLATINUM BY GASES.

By H. HELMHOLTZ.

THE results communicated by Professor Helmholtz in 1873 to the Academy of Berlin, led him to the belief that by galvanic polarization, not only the particles of gas superficially imposed, but also those deeper in the substance of the platinum must play an important part, the probability of which fact has already been brought forward in the researches of Graham on palladium and platinum. To demonstrate exactly the occlusion of the gases by platinum through galvanic polarization, Helmholtz supplied Dr. Root, of Boston, Mass., with the means of investigating whether the hydrogen given off by galvanic polarization on one side of a platinum plate could be remarked after some time on the other side, so that galvanic polarization might be brought about. These researches have given the experimenters the results they anticipated. The apparatus used was as follows: To both sides of a platinum plate 0·02 mm. in thickness placed vertically, were fixed by sealing-wax the open ends of two tubulated glass receivers, one opening of each being fastened to the platinum plate already mentioned, the other open ends being turned in an open direction. The edges of the platinum plate projected beyond the cement joining it to the glass vessels, so as to prevent any liquid contact between the fluids placed in them. The glass vessels were filled with distilled water acidulated with one or two drops of dilute sulphuric acid and two platinum electrodes were fixed vertically in the open and upturned ends. Before conducting the experiments, the authors tested the purity of the platinum, and the apparatus filled with water was allowed to remain for a considerable length of time to be certain of its junctions being airtight. The experiments are mentioned in detail, but as no general conclusions are stated, it is difficult to form an abstract, and it is therefore advisable that reference should be made to the original paper *in extenso* for the results obtained.—*Pogg. Ann.*

GALICIAN OZOKERITE AND CERESIN.

By J. GRABOWSKY.

THE author describes the method of mining the above minerals, and states that the best "earthwax" or ozokerite should have a pure yellow or greenish color; this, after having been melted, yields "a prime" earthwax, generally used for the manufacture of "ceresin." Occasionally ozokerite is found compact and hard, melting above 100°, and dichroic (dark green in reflected, and pure yellow in transmitted light). Its composition is expressed by the formula $C_n H_{2n}$, and it appears to be produced by the oxidation and condensation of petroleum hydrocarbons, in the same way as naphthalene forms dinaphthyl. By supposing an oxidation of hexane and octane we obtain compounds of the formula $C_n H_{2n}$, which again may condense with hydrocarbons of the marsh gas series, thus:

$$2C_6H_{14} + O_2 = C_{12}H_{26} + 2H_2O,$$
$$C_{12}H_{26} + C_6H_{14} = C_{22}H_{46} + H_2O.$$

The method of separating the wax from the gangue by melting, then clarifying and casting into moulds, is described.

Paraffin and other hydrocarbons are prepared from ozokerite by distillation, the paraffin being pressed, treated with sulphuric acid and soda, and then filtered through animal charcoal. The best ozokerite, treated with sulphuric acid and animal charcoal, yields "ceresin;" to cause it to resemble beeswax more closely, it is colored with gamboge or alkanet. Good "ceresin" is distinguished from beeswax by not being so easily kneaded by the fingers, and by being scarcely attacked by concentrated sulphuric acid.—*Pharm. J. Trans.*

ORIGIN OF MINERAL OILS.

By D. MENDELEJEFF.

THE author, having visited the mineral oil springs in the Caucasus and in Pennsylvania, has formed a hypothesis of the origin of these oils. The view held by many, that the oil is a decomposition product of organic remains, is rejected, chiefly on the ground that these oils are found in tertiary strata in the Caucasus, and in Devonian and Silurian strata in Pennsylvania, and must have been formed in underlying and still older strata, where but a few organic remains can have existed. The author assumes, as a consequence of the condensation of the earth's substance from vapor, that the interior of the earth must consist largely of metals (iron predominating) in combination with carbon. Wherever fissures have been produced in the earth's crust by volcanic action, the water, which of necessity made its way into the interior, and thus came into contact with metallic carbides at high temperatures and pressures, must have given rise to saturated hydrocarbons, which have ascended in the form of vapor to strata where they condensed.—*Deut. Chem. Ges. Ber.*

GAS APPARATUS FOR QUANTITATIVE BLOWPIPE ANALYSES.

By T. HIRSCHWALD.

To the foot of an ordinary Bunsen burner is screwed a short upright tube for the blast, having a fine opening at the top; above this is placed a jacket, having a side opening for the introduction of gas, and narrowed at a few millimeters above the opening of the blast-pipe; a carrier screwed on to the outer tube serves to hold a small furnace of coke or graphite, bored vertically, and allowing of the internal suspension of the crucible on a platinum ring, the whole being covered by a lid. Lead precipitate, etc., can be more easily heated in 2—3 minutes with such a vertical blowpipe, than with the ordinary ones in use.—*Chem. Centr.*

BORIC ACID; METHODS FOR ITS DETECTION; ITS ORIGIN AND MODE OF FORMATION.

By M. L. DIEULAFAIT.

SPECTRUM analysis, under the conditions laid down by the author, permits us to detect with certainty the presence of $\frac{1}{10000000}$ of a grm. of boron. The method with the hydrogen flame as described by the author shows distinctly the existence of $\frac{1}{1000000}$ of a grm. of boron. Boric acid is a normal constituent of the waters of existing seas. Contrary to what might have been expected boric acid concentrates itself in the last mother liquors of the salt marshes, above the carnallite in the deliquescent salts, in the state of borate of magnesia. But it is exactly in that place and under these conditions that boric acid is met with at Stassfurt. The borate of magnesia of this celebrated deposit therefore is not, as commonly admitted hitherto, of volcanic origin, but it is purely sedimentary. The presence of boric acid can be shown in a single drop of natural sea water.

THE ROTHAMSTED AGRICULTURAL EXPERIMENTAL STATION.

MR. LEWES was the founder of the Rothamsted Experimental Station, and commenced experiments with different manuring substances, first with plants in pots, and afterwards in the field, soon after entering into possession of his hereditary property at Rothamsted,* in 1834. The researches of De Saussure on vegetation were the chief subjects of his study to this end. Of all the experiments so made, those in which the neutral phosphate of lime, in bones, bone-ash, and apatite, was rendered soluble by means of sulphuric acid, and the mixture applied for root crops, gave the most striking results.

In 1843 more systematic field experiments were commenced, and a barn which had previously been partially applied to laboratory purposes became almost exclusively devoted to agricultural investigations. The foundation of the Rothamsted Experimental Station may be said to date from that time (1843).

The Rothamsted station has up to the present time been entirely disconnected from any external organization, and has been maintained entirely by Mr. Lawes. He has further set apart a sum of £100,000, and certain areas of land, for the continuence of the investigations after his death.

In 1854–5 a new laboratory was built, by public subscription of agriculturists, and presented to Mr. Lawes, in July, 1855, from which date the old barn-laboratory was abandoned, and the new one has been occupied.

From June, 1843, up to the present time, Dr. J. H. Gilbert has been associated with Mr. Lawes, and has had the direction of the laboratory.

The number of assistants and other helps has increased from time to time. At first only one laboratory man was employed, but very soon a chemical assistant was necessary, and next a computer and record-keeper. During the last 25 years the staff has consisted of one or two, and sometimes three, chemists, and two or three general assistants. One of these is usually employed in routine chemical work, but sometimes in more general work. The chief occupation of the general assistants is to superintend the field experiments—that is, the making of the manures, the measurement of the plots, the application of the manures, and the harvesting of the crops; also the taking of samples, the preparation of them for preservation or analysis, and the determinations of dry matter, ash, etc. These assistants also superintend any experiments made with animals. There are now about 25,000 bottles of samples of experimentally-grown vegetable produce, of animal products, of ashes, or of soils, stored in the laboratory.

A botanical assistant is also occasionally employed, with from three to six boys under him, and with him is generally associated one of the permanent general assistants, who at other times undertakes the botanical work.

Two or three (for some time past three) computers and record-keepers have been occupied in calculating and tabulating field, feeding, and laboratory results, copying, etc.

One, and sometimes two, laboratory men are employed.

Besides the permanent laboratory staff, chemical assistance is frequently engaged in London or elsewhere, and in this way, for some years past, Mr. R. Richter, of Berlin, has been almost constantly occupied with analytical work sent from Rothamsted.

* Rothamsted is in Hertfordshire, 25 miles from London, on the Midland Railway; station, Harpenden.

The field experiments, and occasionally feeding experiments, also employ a considerable but a very variable number of agricultural laborers.

Nothing has been done at Rothamsted in the way of manure-feeding stuff or seed control.

The general scope and plan of the field-experiments has been:

To grow some of the most important crops of rotation, each separately, year after year, for many years in succession on the same land, without manure, with farmyard manure, and with a great variety of chemical manures; the same description of manure being, as a rule, applied year after year on the same plot. Experiments on an actual course of rotation with different manures have also been made. In this way field experiments have been conducted as follows:

On wheat, 34 years in succession, 13 acres, 35 plots, many of which are duplicates of others.

Of barley, 26 years in succession, 4½ acres, 23 (or 29) plots.

On oats, 9 years in succession, ⅝ acre, 6 plots.

On wheat, alternated with fallow, 26 years, 1 acre, 2 plots.

On different descriptions of wheat, 9 years, 7 acres (each year in a different field), about 20 plots.

On beans, 31 years (including one year wheat and 5 years fallow), 1¼ acres, 10 plots.

On beans, alternated with wheat, 28 years, 1 acre, 10 plots.

On clover, with fallow or a corn crop intervening, 28 years, 3 acres, 18 plots.

On turnips, 25 years, about 8 acres, 40 plots.

On sugar-beet, 5 years, about 8 acres, 40 plots.

On mangel wurzel, 1 year (in progress), about 8 acres, 40 plots.

On potatoes, 1 year (in progress), 2 acres, 10 plots.

On rotation, 30 years, about 2½ acres, 12 plots.

On permanent grass land, 23 years, about 7 acres, 20 plots.

Comparative experiments with different manures have also been made on other descriptions of soil in other localities.

RAINFALL.

Almost from the commencement of the experiments, the rainfall has been measured—for 24 years in a gauge of one-thousandth of an acre area, as well as in ordinary small funnel-gauge of 5 inches diameter. From time to time the nitrogen, as ammonia and as nitric acid, has been determined in the rain waters.

Three "drain gauges," also of one-thousandth of an acre each, for the determination of the quantity and composition of the water percolating respectively through 20 inches, 40 inches, and 60 inches depth of soil (with its subsoil in natural state of consolidation) have also been constructed. A more numerous series of smaller "drain-gauges," arranged for the investigation of the influence of different crops and of different manures, are in course of construction. Each of the differently manured plots of the permanent experimental wheat field having a separate pipe-drain, the drainage-waters have frequently been collected and analyzed. Professor Frankland has determined the nitrogen, as ammonia, as nitric acid, and as organic nitrogen, and also some other constituents, in many samples both of the rain and of the various drainage waters collected at Rothamsted; and Dr. Voelcker has determined the combined nitrogen, and also the incombustible constituents, in many of the drainage waters.

AMOUNT OF WATER TRANSPIRED.

For several years in succession, experiments were made to determine the amount of water given off by plants during their growth. In this way various plants, including representatives of the gramineous, the leguminous, and other families, have been experimented upon. Similar experiments have also been made with various trees.

ASSIMILATION OF NITROGEN.

Experiments were made for several years in succession to determine whether plants assimilate free or uncombined nitrogen, and also various collateral points. Plants of the gramineous, the leguminous, and of other families were operated upon. The late Dr. Pugh took a prominent part in this inquiry.

EXPERIMENTS ON ANIMALS, ETC.

Experiments with the animals of the farm were commenced early in 1847, and have been continued, at intervals, up to the present time.

The following points have been investigated:

1. The amount of food and of its several constituents consumed in relation to a given live weight of animal within a given time.

2. The amount of food and of its several constituents consumed to produce a given amount of increase in live weight.

3. The proportion and relative development of the different organs or parts of different animals.

4. The proximate and ultimate composition of the animals in different conditions as to age and fatness, and the probable composition of their increase in live weight during the fattening process.

5. The composition of the solid and liquid excreta (the manure) in relation to that of the food consumed.

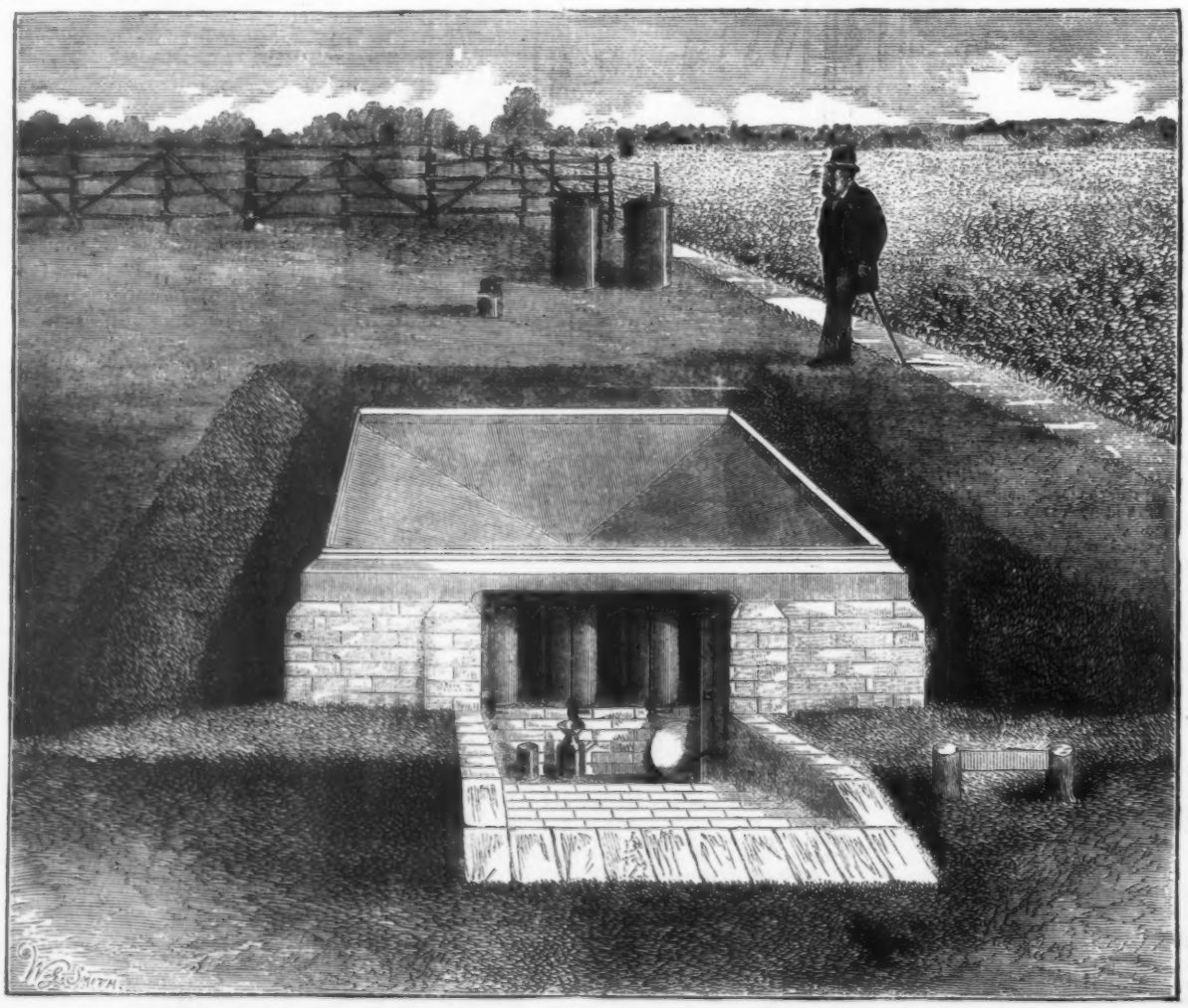
6. The loss or expenditure of constituents by respiration and the cutaneous exhalations—that is, in the mere sustenance of the living meat-and-manure making machine.

To ascertain the composition of the manure in relation to that of the food consumed, oxen, sheep, and pigs have been experimented upon.

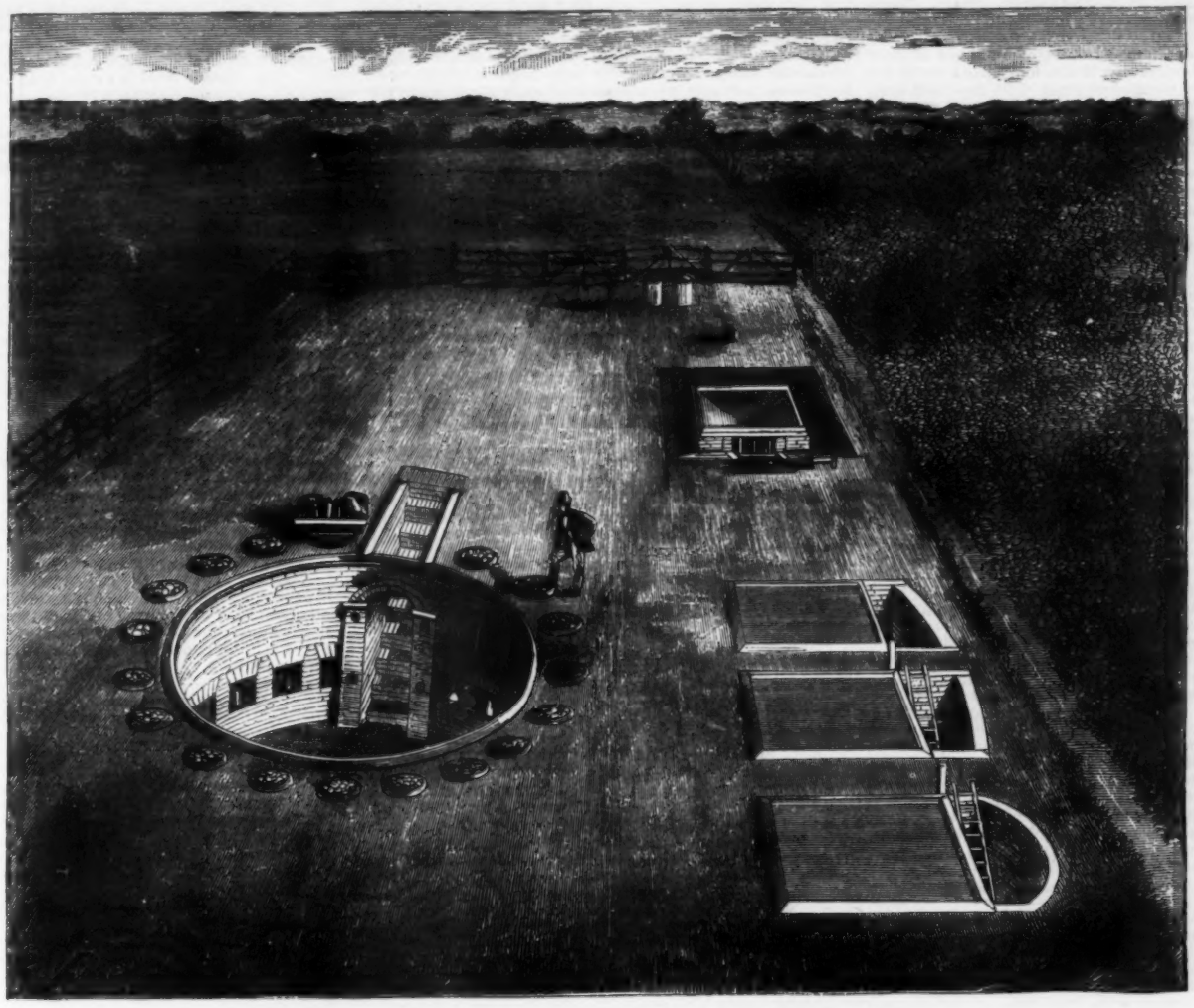
In the case of oxen, the food and litter, sometimes with an acid absorbant, were weighed, sampled and analyzed, the animals were fed in boxes for periods of from five to nine weeks, and the total dung produced was well mixed, weighed, sampled, and analyzed. The constituents, determined in the food and litter on the one hand and in the dung on the other, were dry matter, ash and nitrogen.

In the case of sheep no litter was used; the animals were kept in lots of five, on rafters, through which (but with some little loss) the solid and liquid excreta passed on to a sheet-zinc flooring at such an incline that the liquid drained off at once into carboys containing acid, and the solid matter was removed two or three times daily, and also mixed with acid. The constituents determined in the food and manure were dry matter, mineral matter, sometimes woody fibre, and nitrogen.

In the case of pigs, individual male animals were experimented upon, each for periods of three, five, or ten days only. Each animal was kept in a frame preventing it from



RAIN-GAUGE AT ROTHAMSTED: AREA, ONE-THOUSANDTH OF AN ACRE

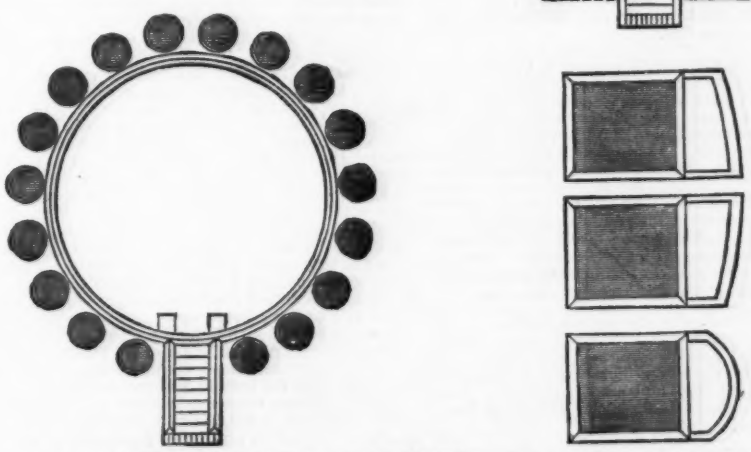


DIFFERENTIAL DRAIN-GAUGES AT ROTHAMSTED.

turning round, and having a zinc bottom, with an outlet for the liquid to run into a bottle; and it, was watched night and day, and the voidings carefully collected as soon as passed, which could easily be done, as the animal never passed either fæces or urine without getting up, and in getting up he rang a bell, and so attracted the notice of the attendant. The constituents determined were, in the food and fæces, dry matter, ash, and nitrogen; and in the urine, dry matter, ash, nitrogen, and urea.

The loss or expenditure of constituents by respiration and the cutaneous exhalations has not been determined directly, that is by means of a respiration apparatus, but only by difference, that is, by calculation founded on the amounts of dry matter, ash, and nitrogen in the food and in the fæces and urine.

Independently of the points of inquiry above enumerated,



A, RAIN GAUGE; B, SMALLER DRAIN-GAUGES; C, LARGER DRAIN-GAUGES.

the results obtained have supplied data for the consideration of the following questions:—

1. The characteristic demands of the animal body (for nitrogenous or non-nitrogenous constituents of food) in the exercise of muscular power.

2. The sources in the food of fat produced in the animal body.

3. The comparative characters of animal and vegetable food in human dietaries.

In conjunction with Professor Way, an extensive investigation was undertaken on the application of town sewage to different crops, but especially to grass. The amount and the composition of both the sewage and the produce grown were determined, and in selected cases the composition of the land drainage water was also determined. Comparative experiments were also made on the feeding qualities of the differently-grown produce, the amount of increase yielded by oxen, and the amount and the composition of the milk yielded by cows being determined. In this inquiry part of the analytical work was performed at Rothamsted, but most of it by Professor Way in London.

The chemistry of the malting process, the loss of food constituents during its progress, and the comparative feeding value of barley and malt have been investigated.

Although many of the results of the investigations above enumerated have already been published, a large proportion as yet remains unpublished.—*Agricultural Gazette.*

THE CRANBERRY AS A POT PLANT.

A CORRESPONDENT of the London *Gardener's Magazine* gives the following account of his experiment in the way of a portable cranberry meadow, which some of our readers may like to try for themselves:

Four years ago I received from a friend about a pint of selected American cranberries (*Oxycoccus macrocarpa*). They were nearly as large as cherries, and of the most beautiful amber and crimson-scarlet tints. I planted these, and soon became possessed thereby of numbers of fine plants. A considerable portion of these were planted out, and, like their predecessors, came to little good. But a few that I have reserved for pot culture have fruited freely, and are extremely handsome plants. These have been grown in spongy peat in large pans, which are kept in about one inch in depth of water. I believe my failure in cranberry culture to have resulted from keeping the plants too wet, for although they are natives of bogs we do not find them in water-courses; my pot plants did not thrive when I kept them deeply immersed, as I did at first, cherishing the idea that they must be aquatic in constitution. When I adopted a maximum of an inch of water for the pots to stand in, the plants made rapid progress. I can assure those who fine time and have the good taste to grow something besides bedding plants, that the American cranberry is, for its beauty alone, well worthy of their attention.

CRANBERRY CULTURE.

By A. K. GILE, Alfred, Me.

I PROPOSE to give you the details of my practical operations in raising cranberries, and also my new and improved methods of harvesting, cleaning, drying, and sorting cranberries, by which I avoid hand-picking and secure my berries for a small fraction of the cost of the old-fashioned way and in far better condition.

My attention was first called to the object of cranberry culture fully twenty-five years ago, while visiting friends in Canton, Mass., and by reason of examining a bog in that town I was led to examine my own home chances for a suitable cranberry bog. I owned about three acres of peaty soil, the peat measuring from six inches to four feet in depth, and underlaid by a grayish fine sand, which seemed a favorable opening. But I found I could not command a supply of water, hence I was obliged to abandon this spot, and it was fortunate I did, since the frost has struck there almost every year before the berries would have been fit to harvest. I read all the literature I could obtain on the subject of cranberry culture, but could find nothing that gave a description of soils to meet my case.

Finally, after diligent search and investigation, I discovered the best cranberries I had ever seen, growing in the bottom of a sloping ditch, that had been dug out with an ox-scraper for the purpose of benefiting the adjoining grass land. The vines were growing in the sandy subsoil, and extending up the slopes to the soil which had been removed from the ditch. I noticed particularly that the fruit was much the best where there was no soil, while the vines were more luxuriant where the soil existed. Herein, then, I found my first encouragement, since I owned a dozen acres of just such land, with a similar subsoil, covered by six or seven inches in depth of mucky soil, also with what I supposed to be an abundance of water, though in severe droughts the supply has occasionally failed me.

Following up the trail thus discovered I found places in different towns and locations similarly situated as regards soil, and, in full confirmation of my first discovery, in every case the berries were best when the vines were growing in the subsoil. I then determined to go ahead on this basis, but how to get rid of the soil was my first problem. I had learned from various persons and authorities that $1.50 per square rod was an average cost of scraping a bog, preparatory to sanding. This was far too great an outlay for me to make, especially in an experimental operation; and again, what could I do for pickers on so large a territory? I had read of 200 pickers being engaged at one time on a lot even less in size than mine—a far greater number than could be

secured for such work in a little country village. These were hard problems at first sight, but I will give you my solution.

First, to dispose of the soil: Get an old mill-saw of good metal, cut it into pieces twenty inches long, grind ten inches of the backs of each piece sharp, and drill two bolt-holes six inches apart at the other end of each blade. Next make a machine similar in form to a common hand-rake and large enough for two horses and have a seat upon it to ride; then secure five pieces of hard-wood plank to the head of the machine in such a position that they shall project ten inches behind it with a downward inclination, such that they may drag upon the ground and raise the head from the ground. These may be one foot apart, and upon them the blades above mentioned may be bolted, at an angle of 35°. Now attach your horses and drive to one corner of your lot, get upon the seat and drive back and forth till you have cut all the soil into strips one foot wide and as long as your lot, without moving it from its place. In turning at the ends step off, and the horses will draw the blades out of the ground by reason of their upward inclination, when, with care, you can turn without breaking them.

Have a good mill file and keep well sharpened. Next take a plow suitable in size for your horses, take off its cutter and wheel, and a little back of the place at the latter bolt a piece of hard-wood plank, letting it extend down so low as to act as a gauge instead of the wheel. Upon this bolt one of the blades of the machine already described, and at the same angle of 35°, letting it project backward to within three inches of the plow point and downward to a level with its under side. Procure a plow point so soft that it may be drilled, and rivet upon its under side a strip of cast-steel plate two or two and a half inches wide and as long as the wing of the point, letting the edge project forward beyond the edge of the wing three-quarters of an inch, and grind it sharp to cut off the tough, vertical roots, which sometimes look and cling like tarred strings.

Having determined the distance of your windrows, say two and a half or three rods from center to center, put up rows of small sticks (not stakes) where the bases are to be, and back-furrow five times around each base, leaving five or six feet unplowed to be covered by the windrow. These must run at right angles with the direction the sod has been cut. If you examine the furrows plowed you will find them to consist of *detached* sods one foot long and as wide as the furrows, and if plowed so fine as to cut off all the vertical roots, they my be very easily handled. Two horses will draw this plow when sharp through tough meadow-grass roots, if the sod has been well cross-cut with the machine, and quite as easily as six oxen could draw the same plow before it was changed; being mainly the difference between cutting and tearing that kind of roots. The furrow, consisting of detached sods, offers less resistance to the furrow-board than it otherwise would. Attach an ox-shovel or scraper to a rocker upon a pair of wagon wheels with a long axle, so as to turn about easily, and drive across the lots as you would to rake hay into windrows of the same direction.

Hitch the scraper under the five furrows of the first windrow, and move them their bigness, and dump them upon the base; pass over the next five furrows, and the two rods of unplowed grass ground, till you come to the first five furrows of the second windrow; move them to its base and dump, passing on as before till you cross the lot, then turn and come back in the same track, dumping each five furrows you left upon those you had already dumped, and so continue till you have gone over the whole lot, which will then consist of partly formed windrows of ten furrows each. From the intervening grass ground back-furrow five bouts more, and proceed as before, till you finish. By plowing only enough for one scraperful at once you avoid treading down the sods before they are to be removed, and also have an open furrow in which to set the scraper to be filled. My lot has nineteen windrows, giving eighteen beds, each having an inlet and an outlet of its own, the inlets connecting with my reservoir, and the outlets with a main ditch running to and under my cranberry house.

When I wish to harvest a bed I open its inlet and flood it, just covering all its vines. This inverts every berry and also raises it, or brings it as near the surface as the length of its stem will permit, while the vines do not rise, thus allowing the berries to be freed without tearing the vines, when they will instantly rise upon the surface. After the berries are freed from the vines upon any desired bed, all that have not passed to their place of destination by the current are boomed toward the outlet into the main ditch, and the current takes them to the cranberry house, leaving no scattering ones by the wayside, through the use of anchored floats that keep them in its center.

My floating boom is made thus: Take a board 1¼ inches thick, 9 or 10 inches wide, and 30 feet long, for the main part; within, say 4 feet of each end of this, attach a piece of inch board 9 or 10 inches wide and 8 or 9 feet long, at an angle of 15° with the main part, and keep each in place by a brace passing to it from the end of the main part. This gives the boom, when in use, the appearance of advancing with outstretched arms to gather the berries. These arms should be heavy enough to hold the main part of the boom up edgewise, and are themselves in that position. Attach a rope with a loop to each arm of the boom to draw it by, and let two men throw the same over their shoulders and walk abreast down the opposite sides of the bed, drawing the boom between them. Each man as he moves along will carry a shovel or scoop in his hands, with which he will drive the berries toward the center of the bed by wavelets made to flow in that direction.

If any of them are lodged upon the bank by reason of wind or otherwise, a scoopful of water thrown upon them from the right direction will raise and float them off without injury to them or loss of time by the men. To get the boom back to its starting place, tip it upon its back, letting the arms project upward, and it will float as easily as a boat. I timed two of my men who were booming last fall, and noticed that they cleared one-half acre in three-quarters of an hour, driving all the berries into the main ditch, whence they floated to the cranberry house, without help or care.

The windrows should, if convenient, be made to point westerly or northwesterly, so that they may not obstruct the wind in time of frost when the lot may not be flooded, since the frosts of September and October almost always occur with what little wind there may be blowing from that direction. These windrows are also useful in breaking the fury of the cold, northeast storms, which may come in time to stint and retard the ripening fruit, and in allowing one or more beds to be flooded when I prefer not to flood them all; also in economizing the water in case the lot is not a dead level, as in my own case.

One corner of my lot was eighteen inches lower than the opposite corner, and required that extra depth of water before the upper vines got any, thus involving a great loss, which is mostly saved by dividing it into eighteen distinct beds, requiring but ⅓ as much waste. Among their disadvantages is the fact of affording a home for insects, though by burning the grass upon them in the night while the vines are flooded they may be exterminated, millers and moths not shunning the light, but being attracted by it as they are by the light of the lamp. Another disadvantage is in the fact of the vines running up the sides, and bearing berries that may not be flooded with the others in times of frost, thus causing a liability of being gathered with the flooded berries and softening in the berries, hurting the sale of the whole lot.

However, in size, uniformity, and lustre, I have seldom seen my berries excelled by any in Boston market, which I attribute largely to the adoption of my peculiar methods. I will send you for next week's issue a description of my cranberry house and of my automatic machines for taking the berries from the water, and other interesting details in the process, the whole description being too long for a single communication.—*Boston Cultivator.*

HORTICULTURAL NOTES.

VELOCITY OF SAP.—We published a year or two since an abstract of some experiments performed by Prof. Pfitzer of Heidelberg, on the velocity of ascending sap in plants. He first allowed the plants to droop their leaves from want of water. They were then freely watered. In one case, leaves ten inches above the soil began to revive in three minutes after watering. In other instances, the velocity was as high as sixteen feet in an hour, and in other extreme cases, by the use of the lithium nitrate, 32 feet in an hour was obtained in bright sunshine. More recently, experiments were made with indigo and carmine, such as is used by microscopists for water and lithium, with similar results. Prof. Koehne employed shoots cut under mercury, and in a few minutes they showed a rise of mercury in the stem from 20 to 38 centimeters, or about 8 to 15 inches. In the sunflower, which is well known to throw off water rapidly, the sap was found in an extreme case to move at a rate of over 80 feet in an hour.

CULTIVATING ORCHARDS.—The *Rural World* gives an experiment to show the difference between cultivating trees in an orchard, and seeding to grass. Two young orchards were planted many years ago at the same time, and from the same block of trees. One was cultivated with corn several years, and the trees grew thriftily and came soon into bearing. The other was seeded to clover the second year, and remained in clover four years. At the end of these five years the trees cultivated with corn were so much larger that no one would have thought they had been set out the same year. The editor remarks that some farmers think all they have to do is to plant trees and let them take care of themselves, and then asks, "Do they plant potatoes and corn, and let them take care of themselves?" The above experiment was made in the fertile regions of Missouri.

LAYING DOWN GRAPES.—Occasionally there are winters through which hardy grapes pass more safely if laid down on the ground. Sometimes such prostrated vines are the only ones that bear the following season. We have seen a recent account of a vineyard in Southern Ohio, where a part of the grapes were laid down and bore a good crop this year, while from a thousand vines on the trellis not two bushels of grapes were obtained. We find *stove wood* the most convenient for holding down the vines.

THE EARLY PEACHES.—A correspondent of the *London Garden* says that the Early Beatrice is only second rate in flavor, of small size, does not carry well, and is fit only for growing in pots. He discards the Early Rivers, as he finds it of poor flavor and cracking at the stone. The Early Louise proves to be an excellent peach and worthy of being extensively grown. He commends Hale's Early as a good variety, and urges the trial in England of the Alexander and Amaden.

SNYDER BLACKBERRY.—Dr. Sylvester stated at the Baltimore meeting that he found this fruit to be small, but the bush proved very hardy with him at Lyons, N. Y. Wm. Parry, of New Jersey, said it was the only blackberry on his grounds entirely free from rust.

KILLING WASPS.—A writer in the *London Garden* gives the following mode of killing wasps when they prove destructive to fruit: Procure cyanide of potassium from the druggist, and add it at the rate of one ounce to half a pint of water. In this wet a handful of cotton and thrust it into the mouth of the wasp hole. The fumes destroy the insects in less than half an hour. In one instance, 4,000 dead wasps were counted in a single nest. This may seem like a large story; but one thing is certain—that the cyanide of potassium is a deadly poison to all insects, and entomologists use it in this country for the instantaneous death of their specimens by touching the thorax with a tenth of a drop on a metallic point. Those who used it should therefore exercise great caution to do themselves no harm with it.

JAPAN CREEPING EUONYMUS (*Euonymus radicans*).—The *Gardener's Monthly* recommends this newly introduced plant as a substitute for the English ivy where the winters of the north are too severe for the latter. The leaves are evergreen, and the stems throw out roots and antlers to walls. Or it may be treated as a bush, or used for the edging of flower beds; its various uses increasing its value.

WORMS IN FLOWER POTS.—Among the remedies we have seen recommended is lime water, warm water, and an infusion of tobacco. In using lime water, stop the hole at the bottom of the pot, and deluge the soil with it, and the worms will come to the surface and may be removed. In a few hours open the hole and allow free drainage again. If warm water is used, let it be examined with a thermometer and reduced to about 120°. If the pot is set in warm water and kept at about this degree of heat, or a little higher, the worms will come to the top. The small white worms are destroyed with largely diluted carbolic acid.

UNFERMENTED WINE.—Dr. Goss gave the following simple directions at the meeting of the Potomac Fruit-Growers' Society, for making wine from grapes and other fruits without fermentation: Press the juice from the crushed fruit; then add to the pomace one fourth as much water as there is juice. Press this also in the same vessel. This causes the juice to settle or filter more perfectly. When settled, boil to one third the original bulk, in a glass, stone, or porcelain-lined vessel, and set in another vessel containing water. To each quart of this syrup add a tablespoonful of salt. This is the whole process. It should be well corked and placed in a cool place, and will keep for years.

THE "TUMBLE WEED."—Some of the papers are discussing this weed and its properties. It is the *amaranthus albus* and is not so bad a weed as another species of amaranthus, the common green amaranth which is sometimes called "pig weed." The tumble weed is named from its globular form when fully branched, so that, when loosened from its root in autumn, the wind rolls it long distances over the fields. In early years we have often seen them rolled thirty or forty rods by the wind, till arrested by fences. Some other plants possess this peculiarity.—*Country Gentleman.*

POULTRY HOUSES.

THE *Carolina Farmer*, one of the best of our Southern exchanges, has the following judicious remarks on its use for poultry houses:

Without a free use of whitewash no poultry breeder can expect to keep his fowls healthy for any length of time, and to a neglect of this can be attributed many of the disappointments and much of the loss experienced by amateurs, who do not realize, until they have paid dearly for the experience, that cleanliness is one of the first principles of success in poultry keeping, and that lime, in different forms, is an invaluable agent in promoting cleanliness in poultry houses and amongst fowls. Where it can be done without too much expense, we would advise persons, in building their poultry houses, to use planed boards—at least planed on the inside—in preference to rough ones, for it is far easier to keep the fowl houses clean when smooth boards are used, while the lice and other vermin cannot so readily find a lodging-place. As a preventive is cheaper and better than a cure, we would advise those who build a poultry house to give it a good whitewashing, both inside and out, before the fowls are let inside. To make the whitewash still more distasteful to the vermin which have such a taste for poultry, mix a small quantity of carbolic acid with the wash, stir it well till it dissolves, and then apply. It is not injurious to the fowls, but is to vermin, and at the same time, is a deodorizer and disinfectant.

INFLUENCE OF HUNGER ON THE WEIGHT OF CATTLE.

CATTLE from Galicia and Bukonina, for the Paris market, are transported by rail to Linz, without food or water; here they are put into stalls, fed and inspected. After two days they are reshipped, and four days later arrive in Paris, during which time they are neither taken from the cars nor receive food or water. On leaving Linz, they possess an average weight of 700 kilogr., and on their arrival in Paris, only 560 kilogr., thus losing, on the railway journey, 20 per cent. of their weight.

Sheep from Russia, for the Paris market, journey four days without food or drink, to Vienna, where they are stalled and fed. They are then reshipped for Paris, being six days on the road, and fed and watered only once, either at Strasburg or Metz. On leaving Vienna, they have an average weight of 55 kilogr.; on arriving in Paris, only 45 kilogr., thus losing more than 20 per cent. of weight by the way.—*Thiermedicin.*

KEEPING EGGS.

THE following, from the third Report of the National Butter and Cheese Association, gives the method of preserving eggs which is practised by large dealers:

To make the pickle, use stone lime, fine salt and water in the following proportions: One bushel of lime, 8 qts. of salt, 25 10-qt pails of water. The lime must be lime that will slake white, fine and clean. Have the salt clean and the water pure and sweet, free from all vegetable or decomposed matter.

Slake the lime with a portion of the water, then add the balance of the water and the salt. Stir well three or four times at intervals, and then let it stand until well settled and cold. Either dip or draw off the clear pickle into the cask or vat in which it is intended to preserve the eggs. When the cask or vat is filled to a depth of 15 or 18 inches, begin to put in the eggs, and when they lie, say about 1 foot deep, spread around over them some pickle that is a little milky in appearance, made so by stirring up some of the very light lime particles that settle last, and continue doing this as each lot of eggs is added. The object of this is to have the fine lime particles drawn into the pores of the shells, as they will be by a kind of inductive process, and thereby completely seal the eggs. Care should be taken not to get too much of the lime in—that is, not enough to settle and stick to the shells of the eggs, and render them difficult to clean when taken out. (The chief cause of thin, watery whites in limed eggs is that they are not properly sealed in the manner described. Another cause is the putting into the pickle old stale eggs that have thin, weak whites.) When the eggs are within 4 inches of the top of the cask or vat, cover them with factory cloth, and spread on 2 or 3 inches of the lime that settles in making the pickle, and it is of the greatest importance that the pickle be kept continually up over this lime. A tin basin (holding about six to eight dozen eggs), punched quite full of inch holes, edge muffled with leather, and a suitable handle about 3 feet long attached, will be found convenient for putting the eggs into the pickle. Fill the basin with eggs, put both under the pickle and turn the eggs out, they will go to the bottom without breaking.

When the time comes to market the eggs, they must be taken out of the pickle, cleaned, dried and packed. To clean them, secure half of a molasses hogshead, or something like it, filling the same about half full of water. Have a sufficient number of crates of the right size (to hold 20 to 25 dozen eggs) made of laths or other slats, placed about three-quarters of an inch apart. Sink one of these crates in the half hogshead, take the basin used to put the eggs into the pickle, dip the eggs by raising it up and down in the water, and if necessary to properly clean them, set the crate up and douse water over the eggs; then, if any eggs are found, when packing, that the lime is not fully removed from, they should be laid out and all the lime cleaned off before packing. When the eggs are carefully washed, they can be set up or out in a suitable place to dry, in the crates. They should dry quickly, and be packed as soon as dry. In packing, the same rules should be observed as in packing fresh eggs.

Vats built in a cellar around the walls, with about half their depth below the surface, about 4 or 5 feet deep, 6 feet long, and 4 feet wide, are usually considered the best for preserving eggs in, although many use and prefer large tubs made of wood. The place in which the vats are built, or the tubs kept, should be clean and sweet, free from all bad odors, and where a steady, low temperature can be maintained—the lower the better, that is, down to any point above freezing.

LECTURES ON PARALYSIS AND CONVULSIONS AS EFFECTS OF ORGANIC DISEASE OF THE BRAIN.

Delivered at the Bellevue Hospital Medical College, N. Y., 1877.,

By C. E. BROWN-SEQUARD, M. D.

LECTURE I.

GENTLEMEN: In the beginning of the course of lectures that I shall now have the honor of delivering to you, it is important that I should say that there are two kinds of types of manifestations of cerebral disease. There are two sets of absolutely distinct manifestations of cerebral lesions, which can, however, be brought, and moreover ought to be brought, to one common type. The first variety consists in the immediate stoppage or arrest of a function, or of any activity; and the other set consists in exactly the reverse, *i. e.*, the setting in play of an activity, or the increase of a function. The difference lies, then, in the state produced in an activity or a function. In one case there is an inhibition, an arrest, while in the other there is the setting in action of a power or a function. But, as I will try to prove hereafter, there is an element common to both these conditions.

The first is identically the same as the second as regards that element. A cessation of activity depends upon one and the same cause as a stimulation of activity. In both instances an irritation starts from the place of a lesion in the brain, it is forwarded to cells at a distance, and there acts on these parts so as to stimulate them to act, or to inhibit their activity. So a hæmorrhage in the brain, irritating the part where it is, causes through the propagation of that irritation to cells at a distance either convulsions or paralysis, or both successively, *i. e.*, an action, or the cessation of an action. We have to deal in reality with one great source of difficulty; we have to recognize only one kind of disturbance.

There are, in truth, no varieties, and it is most important to recognize this view, not only to satisfy our minds in regard to the explanation of the phenomena that occur, but also because it leads to a rational system of therapeutics; and I may say at once, as a sort of preface, that these therapeutic means which are in accordance with what I state will in a short time become more fully developed; some of them have already been fully proven, and others will follow.

Before going further, I will add, that in our time, the means of treatment of brain diseases have made a wonderful start, and are rapidly improving, and certain facts which I shall have to relate further on prove this assertion. The mere application of a plate of metal to the body, or the passage of a galvanic current, are known in many cases to produce wonderful results. If you see a case of epileptiform convulsions, before the loss of consciousness has occurred, it may be arrested at once. An immense new field is open to us; we have to deal with a means of treatment, which, if properly applied, produces results of an exceedingly interesting nature.

It will cause the cessation of paralysis and convulsions in a most miraculous manner. I do not wish to convey the impression that we have as yet arrived at perfection in this new method, but the field is very broad and stretches open before us.

I now come to the point of this lecture which, I will remark, is merely introductory to what will follow. All the facts with which we are acquainted as regards paralysis and convulsions may be explained most easily and naturally by a theory that I shall bring forward, while they are in direct contradiction with the old theories which have hitherto been held. When you see a patient attacked with paralysis on one-half of the body, as for instance paralysis on the left side, with slight paralysis on the opposite side of the face, and a series of other symptoms, according to the old theory the disease must be situated somewhere in the *pons varolii*. With a lesion situated in the same locality we might have a paralysis on the right side of the body and the left side of the face; or again, the whole body might be paralyzed completely. In this case we have to deal with an affection of the base of the brain. We may have a paralysis depending on a lesion on the same side of the brain as that in which the disease exists.

In one case we have paralysis on the right side, in the other, on the left, but the seat of the disease is the same in both instances.

In one case it causes paralysis on one side, in another, on the other. Now suppose a third patient comes to you with disease in the same part; he has paralysis only in the lower limbs, with none whatever in the upper; the face is paralyzed on one side, and the orbicularis muscle is also involved. You see the contradiction of these three cases and you will hesitate in forming an opinion unless you know that when disease exists in one part of the brain, paralysis may occur on the same side of the body. If you were not led by this knowledge you would not make a diagnosis.

You may have still a fourth case. A patient may have total destruction of the *pons varolii* and no paralysis whatever in the limbs, though there may be some in the face. You would be at a loss to locate the lesion unless you knew that destruction of tissue can exist without producing paralysis in the least degree.

You could not arrive at a conclusion on the subject, unless you were aware that a disease can exist anywhere in the brain and produce entirely different symptoms.

I am fully cognizant of the fact that the views I am to criticise are those that are held by most, at the present time. These views have been founded on a series of facts which it is not necessary at present to enumerate. After these opinions had been put forward, it was discovered that the fibres of connection decussate in the upper portion of the spinal cord. It was observed that a lesion in one-half of the spinal cord produced paralysis in the corresponding side of the body, and a disease of the brain produced paralysis on the opposite side. I have no hesitation in saying that these ideas are absolutely and radically false. Paralysis does not depend on the destruction of a nerve centre or of a conductor. The most that can be said is that it does so depend in some cases only. If you take away the whole brain of course you will get paralysis, as there is entire loss of sensation and you have taken away the centres of the voluntary will power.

In the first place let us see about the decussation in the spinal cord. The fact which led to this view are two: The first is, that section above this point produces paralysis on the opposite side, and the other is, that destruction of tissue down to the anterior pyramids likewise produces paralysis on the opposite side of the body.

These experiments were instructive, but there are others which overthrow them. I have been able to ascertain that the anterior pyramid can be cut without a trace of paralysis. Both of the anterior pyramids can be cut and no paralysis follow. If the anterior pyramids, then, are employed as conductors between the will and the muscles, they are certainly of secondary or very slight importance, if the connection exists at all. Now comes a difficulty which Schiff has tried to solve. He endeavored to show that the decussation takes place in the *pons varolii*. There are cases in immense number of diseases of one-half of the *pons varolii* in which paralysis existed on the same side.

Destruction of the whole half of this portion of the base of the brain has produced paralysis on one side only, whereas, if decussation existed here, the conductors from both sides would be destroyed, and paralysis on both sides of the body would result.

I have collected thirty-two or thirty-three cases of destruction of one-half of the *pons varolii*, which should produce complete paralysis on both sides but has not done so. We cannot, then, admit that decussation takes place either in the *pons* or *medulla oblongata*.

In the next lecture I will show that decussation takes place in the spinal cord. There is no doubt that one-half of the brain has a great power of action on the other half—through the anterior pyramids of the *medulla* and the *pons varolii*—and when disease appears on the other side it is simply through a power of changing the action of the cells in the spinal cord, and not a paralyzing influence.

Change in nutrition of cells produces paralysis in most cases.

In disease of certain parts there is a transmission of the degenerative changes to the opposite side. In the posterior part of the lateral columns decussation occurs. A great alteration takes place in distant parts by producing irritation in any one part. We can produce at will epileptiform convulsions in guinea pigs by irritation of certain centres. A change of nutrition takes place very rapidly in the opposite side from that in which the injury is made.

In all the organs of the body a change may take place in one side from irritation or injury of the other, and the same thing occurs in the nervous system. The irritation is propagated from one part to another. In some cases there is stimulation of function, and in other cases there is loss of function.

If we cut one of the posterior columns of the spinal cord, we will get loss of sensation on the same side; if we simply prick it, we may get the result on both sides. We may, by the apparently lesser injury, get more extended effects. The prick produces irritation, and the power of irritation is immense. If you look upon the fact in its proper light you will find that the irritation may spread according to the idiosyncrasy or individuality of the animal.

A simple irritation, such as that produced by a prick, may have an immense variety of effects. If such an irritation is produced in the brain, the animal loses the power of will, and all the cerebral activities are arrested. There may be an inhibition, if you choose to call it so, of most of the activities of the brain and spinal cord.

The irritation must be diffused so as to stop the activities of the cells. A stoppage of the heart's action may be caused by irritation of the inhibitory center.

I think we may admit that paralysis is a mere arrest of the activity of the cells. If you will irritate different parts of the brain you may get a general paralysis, as sometimes exists in what is called "general paralysis of the insane."

You may get a cessation of the power of vision by pricking the optic nerve on the opposite side. We may see by irritating certain nerve cells great alterations in the lungs, in one case a hæmorrhage, in another a different change, and so on.

Hæmorrhage of this nature is not unfrequently produced, as in the case of a certain gentleman in Philadelphia, the founder of a large institution there, who died from a hæmorrhage in the lungs, produced by an irritation of cells in the *pons varolii*. In animals we can produce this effect at will.

I will say, to complete the idea that I shall try to prove, that paralysis may occur from an activity of the inhibitory cells, and also from an alteration in the nutrition of parts. The malnutrition may occur not only in the cells of the spinal cord, but in the nerves, muscles, and every part of the system.

The first cause, then, is inhibition, and the second, alteration of nutrition; and if you ask why a paralysis may occur on the side opposite to a lesion, the answer is, that it will cause an alteration of nutrition on the side opposite to the primary irritation.

There is no difference between the kinds of paralyses or convulsive movements, whether the disease be epilepsy, chorea, or catalepsy; all of these movements can appear on either side of the body indifferently. The theories generally admitted are certainly false, as we have shown that paralysis may appear on the same side as the causal lesion. There is still another fact of importance.

If paralysis depends, as is supposed, on a destruction of centers or conductors, we would not find, as in most cases, that paralysis of the same muscles or groups of muscles can be produced by lesions in widely different situations. The common type of hemiplegia from brain disease will come on, no matter in what part the lesion may be.

We cannot admit that the nervous centers are situated in different places in different individuals, and how can we explain the reason why lesions in different localities should produce the same effects?

Take the *crura cerebri*, which consist of the motor fibres, coming from their cells with which they are in connection. In disease of these parts we should have the paralysis located in certain muscles, according to the seat of the disease, according to the fibres implicated.

But we find, on the contrary, that, whatever the seat of the disease, the muscles affected are the same in every instance.

In 269 cases of paralysis of the arm a lesion was found limited in a certain place—the ascending frontal convolution. Now if the conducting fibres, in connection with the two ends of the nervous route, remained isolated at the base of the brain, a disease in the centers would always produce paralysis of the arm.

In point of fact, it is found that such a lesion may produce paralysis of the leg, or no paralysis at all, or paralysis of the whole body. Now if the centers of motion for the arm are seated in the anterior ascending frontal convolution, paralysis must be produced by irritation, for I have collected forty cases in which disease of the posterior lobe produced paralysis of the arm, and forty cases, also, in which the disease was situated in the frontal lobes of the same side.

In other cases, again, disease situated in other portions produced the same symptoms. We cannot admit, as I mentioned before, that the motor centers are situated in different locations in different individuals, so that there are no grounds whatever for deducing from a number of cases of paralysis of certain portions of the body that the centers for the paralyzed muscles are situated in the place of the lesions.

My former pupil and assistant in London, Dr. Hughlings Jackson, has tried to show a relation existing between particular forms of convulsions and lesions in particular spots. He endeavored to show that irritation of the convolutions surrounding the *corpus striatum* produced convulsive movements on the opposite side of the body.

In a paper recently published I gave more than 160 cases of a lesion of one side of the brain producing convulsions on the same side of the body. According to old opinions, we ought to find the convulsions occurring on one side from lesion of the opposite.

There a great many facts that go to prove that all the old views are entirely wrong. I will only say at this time that an irritation is propagated by fibres from one side to the other.

In cases where there is disease of both sides of the brain, the convulsions may appear in only one side of the body.

We often see in a great many cases an irritation in some part of the system produce effects in a part at a distance. Thus you take a number of persons coming out of a warm theater into the cold air with a portion of the neck exposed. The cold draught striking the same part of the body and causing an irritation may in one person produce a pneumonia, in another a peritonitis, in another inflammation of the bladder, in another a simple cold in the head, and so on.

The same irritation in the same part is the sole cause in the whole number of cases, but the results produced are infinite in variety.

As you see, the effects vary according to the idiosyncrasy of the individual. So in brain affections, which sometimes appear on one side and sometimes on the other, producing paralyses either on the same or on the opposite side of the body.

When you accept these views, that the effects appear not because there is a loss of function, but on account of an irritation; when you admit that the old views are wrong, you can explain all the phenomena that occur, and you will be ready to adopt the plans of treatment I will describe, and apply them successfully.

I have but a few words to add to what I have already said.

If you examine what takes place in the phenomena of brain disease, it will lead you to think that the brain is independent.

Only a very few fibres of connection between the brain and spinal cord are sufficient. It has been assumed that, as regards the power of the action of the will on the muscles, the brain must be considered as the keys of a piano.

When the will acts to produce a movement it was supposed to act upon the nerves as the fingers upon the keys.

This cannot be so, as the fibres of connection between the brain and spinal cord are very few in number. There are many cases where great destruction of tissue takes place without destroying the conductor. The will power acts by a sort of telegraphic communication in producing its effects.

I will simply say here, although I cannot as yet give proofs, that there are other powers of the intellect besides the ordinary mental powers. These latter are extremely limited and cannot reach beyond a certain point.

But there are those among you, gentlemen, sitting in the seats before me, who perhaps one of these days will make some discovery or invention that will make a revolution in our theories and practice.

There are those who have the gift of genius, which is superior to the ordinary mental powers. Discoveries are made not by the ordinary mental powers, but by something above and beyond them. The former puts a question to the latter and it sends back the answer.

We see this illustrated on certain occasions when we are endeavoring with all our powers of concentration to recollect a name that we have forgotten, when suddenly (when we are not thinking of it) the name returns to our memory. This is due to the action of that power, of which I have spoken, which is beyond the ordinary mental powers.

The will power acts on the nerves by a sort of telegraphic communication, and does not act on special muscles at one time, but produces variety and complication of movements at the same time. It never gives an order in this way: "I wish this muscle to act."

Those who use their muscles the best and with the greatest effect are never conscious of doing so.

A LADY PRACTITIONER IN DISGUISE.

A DR. JAMES BARRY served as surgeon in the British Army for more than fifty years, during which time he held many important medical offices, and gained an enviable reputation as a cool and skillful operator. He was of a very irritable temper, and, while stationed at the Cape of Good Hope, fought a duel. Notwithstanding frequent breaches of discipline, he attained high rank in the army, served in many parts of the world, and in 1865 his name stood at the head of the list of inspectors-general of hospitals. In July, 1865, the eccentric surgeon died, and the next day it was officially reported that the doctor was a woman. No suspicion of the surgeon's sex seems ever to have been entertained, even by his most intimate associates. In addition to his other accomplishments, Dr. Barry was an inveterate smoker.—*New York Medical Journal.*

OBSTETRIC MORTALITY IN VIENNA.

A GREAT improvement is reported in the midwifery service at Vienna. There are about ten thousand deliveries during the year. In the last two thousand there were only nineteen deaths, and in the last eight hundred only two deaths. The former great mortality in this clinic was due largely to the carelessness with which students passed to and fro between the dissecting-room and the lying-in wards. Precautions are now adopted, and washing the hands in carbolized water before attending obstetric cases is made imperative.—*New York Medical Journal.*

PROFESSOR SCHLOTTER of Vienna has recently examined the high-priced cosmetic, introduced by Thiellay of London for changing the color of black hair to golden yellow. He recognized in it simply a dilute peroxide of hydrogen, prepared with well water, and which owes its permanence to the great degree of dilution and the presence of a small quantity of free acid.

To ascertain whether there are acari insects in a specimen of flour M. Troupeau recommends placing the flour between two sheets of paper, thin it out by pressure of the finger. If acari are present they appear as small molecules, visible to the naked eye. These may be transferred by means of a moistened point to the stage of the microscope. To study the legs and hairs of acari use a mixture of glycerine and and acetic acid, which increases the transparency.

LESSONS IN MECHANICAL DRAWING,

By PROF. C. W. MACCORD.

Second Series, No. XV.

The Screw Propeller. Continued.

HITHERTO the acting surface of the propeller blade has been supposed to be a portion of the *right* helicoid, in which the rectilinear elements are perpendicular to the axis, as in the square-threaded screw. But there is no reason why the surface of the *oblique* helicoid, or V-threaded screw, shall not be employed in the propeller. We are not aware that it has been, in the exact form in which it is used in the common screw, but very likely it has, since the modifications of the propeller are numbered by the hundred. At any rate it might be, and there is a form which has been extensively adopted, in which the obliquity varies, which still farther complicates matters. Before considering that form, then, we shall describe the process of drawing that in which the obliquity is constant, the acting surface being generated by a right line inclined to the axis at a given angle, and every point describing a helix of the same uniform pitch. It will be seen that such a surface may be "struck up" just as easily as the right helicoid, and in the same manner, it being necessary only to incline the straight-edge to the vertical rod upon which it turns and slides. In order to make a better comparison with the form of blade previously discussed, we shall make the conditions as nearly as may be the same, so that the differences between the figures may be only those due the peculiarities of the surfaces. Referring then to Fig. 90, in the preceding lesson, we observe that, as seen in the view, the space within which the blade sweeps round, is bounded on the forward side by the inclined line *m n*; and we will assume for our oblique helicoid a generatrix of the same inclination. We have seen that the simplest form of the blade, when it is a portion of a right helicoid, is that in which the part used is limited by two planes perpendicular to the axis, as in Figs. 66 and 71; now let us see what will result if we limit this surface in the same way. In Fig. 101, *o c* is the inclined element, the point *c* being at the middle of the length of the hub, which is in this case cylindrical. The point *o* describes a helix upon the outer cylinder, the point *c* one upon the inner, the pitch being the same; the terminations *d*, *e*, and *a*, *b*, of those curves are therefore easily found. But clearly *o* will reach *d* before *c* reaches *a*, since *o x* is less than *c s* in the side view; and indeed it is self-evident that *d a* in the end view will not be a right line, because in the side view it does not represent an element. We may determine the form of this line, however, on general principles, thus: any point, as *p* on *o c*, describes a helix, which, being constructed, is seen in the side view to be cut by the aft plane *x s* at *r*, which, being projected to the corresponding circle in the end view, locates *r*, a point in the required curve *d r a* of the trailing edge.

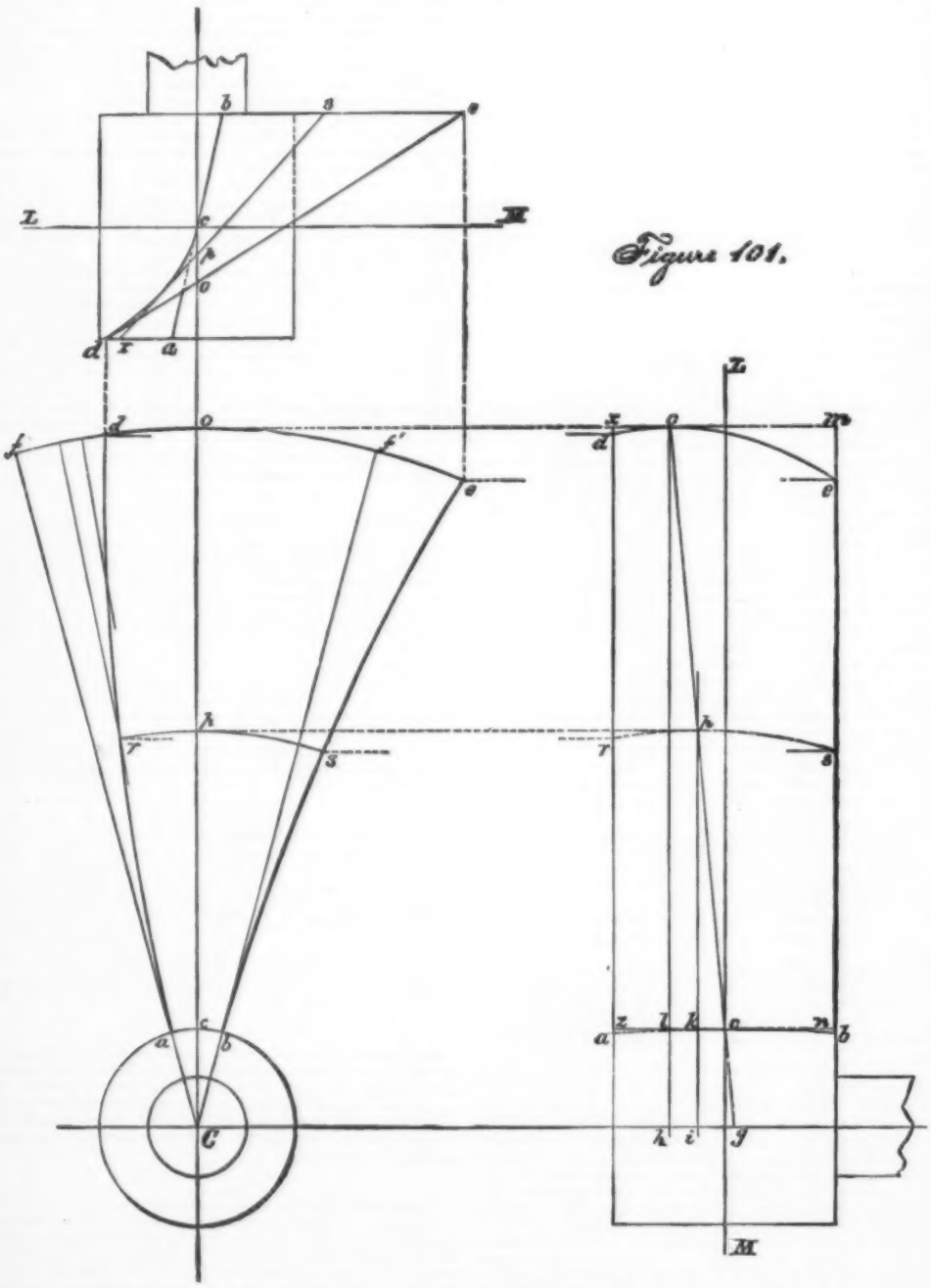


Figure 101.

But though this is a perfectly correct process, and one to which we may in some of our operations be obliged to resort, we may in this case reach the same result in another and a better way. The element *o c* produced cuts the axis in *g*, and as it makes a constant angle with the axis, it makes also a constant angle with planes perpendicular to the axis, such as L M, *p i*, *o k*. And we see from the similar triangles that *o k : p i : : k g : i g*; that is to say, as the element advances through a fixed transverse plane, the distance from the axis of the point in which the plane cuts the element is proportional to the longitudinal advance; but this is proportional to the angular rotation, so that the section of the surface by the plane will be a curve which may be traced by a point having uniform radical advance combined with uniform rotation; in other words, it is an Archimedean spiral.

The most eligible construction of this curve in the end view, then, is as follows: The distances *c s*, *c n*, in the side view are equal, and each is a known fraction of the pitch; so on each side of *o* in the end view we set off the same fraction of the circumference, as *of*, *of'*, and drawing the radii *Cf*, *Cf'*, the intersections with the circle of the hub will fix the points *a* and *b* with precision. Also *o x* is a known fraction of the pitch, and we set off *o d* in the end view, the same fraction of the circumference: then if a tracing point start at *d*, and travel uniformly along the radius *d C*, so as to reach *a* when the radius, rotating uniformly, reaches the position *f C*, it will describe the spiral arc *d r a*, the outline of the trailing edge of the blade. It will be seen that *o m*, in the side view, is as much longer than *c n* as *o x* is shorter: therefore *f' e* in the end view will be equal to *f d*, and the curve *e s c* of the leading edge will be a spiral precisely like *d r a*; as of course it should be, since it is also a section of the helicoid by a plane perpendicular to the axis.

It appears then that, in the end view, the blade under these circumstances is bounded by curves of the same nature as those of the one shown in Fig. 90, but reversed in direction. The construction of the top view of this ideal blade requires no explanation, except as to the visible contour of the back. We have shown the inner and outer helices, *a b* and *d e*, as well as one intermediate one, *r p s*. The element *o c* being inclined, these helices do not intersect at *c*, as they did in the case of the right helicoid: but were we to draw an indefinite number of them, they would, evidently, determine the contour of the back, which must be their envelope, or the curve *c d* tangent to them all, as shown.

In this figure there is no attempt at any similarity between the conditions assumed and those of the screw previously discussed, the object being simply to show the nature of the surface and the mode of drawing it. Now, in Fig. 102, we represent a blade as nearly as may be like that shown in Fig. 90, the diameter and pitch of the screw, the size and form of the hub, the overhang of the aft side, and the space within which the screw is to turn, as seen in the side view, are the same. This space is bounded on the forward side by the line *m n*, to which the element *o c* of the blade is is made parallel, *c* being the middle point of the outline of the hub. We have now to find the form of the blade generated by *o c*, which will just turn within this space, of which the corners are rounded as before. First, in regard to the leading edge; it is clear that this will be absolutely a right line, for *m n* is the position that *o c* will occupy at one time in its motion. That time will be when *o* has moved to the right through the distance *o m*: as *o* describes a helix, we draw through *m* a vertical line, cutting this helix at *e*, the point which in its revolution will rise to *m*. Produce *m n* to cut the axis in *u*: then as *u* remains fixed during the revolution, *u e* is the actual position of the leading edge, which cuts the circle of the forward end of the hub in *b*. Now, *o m* in the side view is a known fraction of the pitch, corresponding to the same fraction of a revolution; therefore, in the end view we set off *oe*, this fraction of the circumference, and draw the radius, *eC*, thus locating *b* also in that view. The construction of the top view needs no explanation; and we see that in each, of those views, the leading edge, *be*, before rounding off the corners, appears as a right line.

Next, in regard to the trailing edge. In the side view, a vertical, through *x*, cuts the helix through *o* in *d*, the extreme point before rounding off the corner: the advance, *ox*, corresponding to the angular motion, *od*, in the end view, the former being a certain fraction of the pitch, the latter of the circumference. We may determine other points in the edge as follows. Any point, as *p* of the generatrix *oe*, describes a helix, lying on a cylinder whose radius is *pC* in the end view. This cylinder will in that view be bounded by the circle through *p*, while in the side view its upper outline will be *pr* parallel to the axis, cutting *xz* in *r*: and *r* in revolving describes a circle which must cut the helix. This circle will be seen edgewise on the side view, as the vertical line through *r*, cutting the helix through *p* in *s*. To save the trouble of constructing this helix, we may measure *pr*, find what portion of the pitch it is, and in the end view set off *ps*, the corresponding fraction of the circumference, thus locating *s* in that view first, projecting it to the vertical through *r* to fix position in the side view, whence its location in the top view is found as usual: in transferring it and other points to the latter view it will be best and most convenient to measure all distances in the direction of the axis from the central transverse plane *LM*.

Pursuing this mode of operation, we observe then, when we draw *vn*, that line intersects *oe* produced in *v*, and that *vs* is greater than *vn* or its equal *om*. The determination of *a* will be more accurately made by cutting off *of*, the same fraction of the outer circumference that *xz* is of the pitch, and drawing *fC*, cutting the circle of the end of the hub in the required point. The curve *acb*, then, in which the helicoid intersects the hub, is not the same as in Fig. 90, the part *ac* being slightly different from the part *cb*, whereas these two portions in the former case were exactly alike. But the process described above will enable us to construct this curve, and it may also be applied in drawing the curves by which the corners are rounded off. Thus the point *k* in the side view describes a circle in revolving, which cuts in the point *t* the helix described in generating the surface by the point *l* of *oe*, whose distance from the axis is the same as that of *k*: and finding the fraction of the pitch represented by *lt*, we set off in the end view *lt*, an equal fraction of the circumference of the circle through *l*, exactly as we did in locating the point *s* as above explained.

The curve *dsa*, in the end view, may however be more systematically constructed, because it may be shown that in this case also it will be a spiral of Archimedes, as will be seen by the aid of the diagram Fig. 103, in which *CC* being the axis, the lines *oy* and *xw* correspond to those similarly lettered in Fig. 102. The line *xw* in revolving describes a cone, which will be pierced by the element *oy* of the helicoid, at points verging in distance from the axis, as it advances. The lines *aw*, *bd*, *ce*, parallel to *oy*, represent this element in different positions, in its true relation to the elements of the cone which it successively intersects: that is to say, when *y* has advanced to *d*, the element *oy* when revolved into the plane of the paper will appear as *bd*, intersecting an element of the cone, which will appear as *xw*, in a point *g*, whose distance from the axis is *gk*, and so on. Now, as *oy* and *xw* make constant angles with the axis, they make constant angles with each other, whatever the advance of *oy*; and from the similar triangles we have the proportion:

$$gk : fh .: wk : wh$$

Thus, as before, the distance from the axis of the point in which the element of the helicoid pierces the cone, is proportional to the linear advance, which again is proportional to the angular rotation. Applying this to Fig. 102, we see that a tracing point starting from *a* in the end view, and traveling uniformly outward on the radius *Cf*, at such a rate as to reach *f* at the same instant when *f*, revolving uniformly about *C*, reaches the point *d*, will describe the outline of the trailing edge of the blade, which may therefore be constructed by points as a portion of such a spiral.

Nor is this a mere matter of abstract interest: for it is much easier as well as more accurate to draw this spiral, and, reversing the mode of operation previously explained, to make use of it in determining the other views. Thus, describing in the end view any circle as *sp*, we draw with the T-square the line *rp* in the side view, cutting *xw* in *v*, then with a triangle draw the vertical through *v*, and finally project *s* to this vertical line. "Very well, if this is so much the better way, why didn't you say so at first, instead of describing another and a worse one?" Because the first method involves a general principle, which it is necessary to understand in order to understand the second method thoroughly, and to be master of the subject. It is not always that secondary methods of operation of this sort can be deduced; and when they can be, it is only by reasoning upon the primary ones.

We have, then, all the information necessary to the complete drawing of the ideal or elementary blade without thickness; the outline or visible contour of the helicoid in the top view of Fig. 102, as in Fig. 101, being determined by constructing several of the helices intermediate between

the outer rim and the hub, and drawing a curve tangent to them all.

If now it be desired to give sensible thickness to the blade, and to determine the appearance presented by the back as well as the front, we proceed in the same manner as though the acting face were a square-threaded instead of a V-threaded screw, as explained in the preceding lessons. The first step is to construct a curve passing through the extremities of a series of normals to the helicoidal face, the lengths of which are determined by a conventional section through the central element, *oc*. And it is in the detail of the construction of the normal that we find the only point of difference between this case and the preceding one. The tangent plane at any point must contain the rectilinear element on which it lies, and also the tangent at the same point to the helix passing through it. We have no difficulty in drawing either of these lines, but this case is complicated by the consideration that the plane thus determined is not seen edgewise in either of our three views, as it was in the case of the right helicoid.

What we must do, then, is to make a new view in which this plane shall be seen edgewise: then the normal, being perpendicular to it, will appear in its true length. This is illustrated in Fig. 104; the reader will at once recognize the end, side, and top views of a blade like that shown in Fig. 101, to which let it be required to draw the normal at *o*.

We first rectify the arc *od* on its tangent, giving *op* in the end view as its length; projecting *p* to *p'*, and drawing *p' o'*, in the top view, we have the tangent to the helix: this being parallel to the paper in that view, the normal will not only be, but in that view it will appear, perpendicular to *p' o'*. Now let us make a view, looking in the direction of this line, as shown by the arrow. The line *p'o'* will be seen as the point *o''*, the axis as a line $O''O'$ perpendicular to *p'o'*, the upper side of the cylindrical hub has a line parallel to $O''O'$, on which *c'* will be seen at *c''*: the element *oc* will therefore appear as *o''c''*, which is not of the true length, but since the plane in which it lies contains *o''*, representing a line perpendicular to the paper in this view, the plane itself is seen edgewise, and the normal will be seen in its true length as *o''n''* perpendicular to *o''c''*. Project *n''* to *n'* on the perpendicular to *o'p'* through *o'* in the top view; then *o'n'* will be the projection of the normal in that view. In the end view, *n* will be perpendicularly under *n'*, and as far above the axis as *n''* is from $O'O'$ in the oblique view. This is most readily set up thus; the plane *op*, tangent to the cylinder on which the helix through *o* lies, being parallel to the axis, will in the oblique view appear as *o' r''* parallel to $O''O'$; therefore in the end view we make *r n* equal to *r''n''* in the oblique view, thus giving *n o* as the projection of the normal whose true length is *o''n''*.

In this manner we proceed, drawing as many normals as may be requisite for the correct determination of the curve through their extremities: it need hardly be said that in order to avoid confusion, in a working plan their constructions should be made on a separate sheet, and the results only transferred to the drawing to be used. By the aid of this curve we can then, as previously explained, fix one point in the back line of any desired cylindrical section of the screw-blade, and the subsequent processes are precisely the same as in Fig. 90. We do not therefore occupy space in repeating the explanation, or add to the complexity of the figures by introducing the "substance" of the propeller at all, but leave this as an exercise for the reader to execute at his discretion; but we do repeat that he will find it greatly to his advantage and convenience to make his drawings on as liberal a scale as possible: constructions which on one scale become bewildering and disheartening by reason of the close proximity of the points and the crowding together of many lines in a cramped space, will, if doubled, trebled, or quadrupled in size, become clear and satisfactory; and the saving in time is of far greater moment than the extra expense of the paper.

By comparing Fig. 90 with Fig. 102, it will be seen at once that the two propellers, though of the same pitch, the same diameter, and turning within the same space, are decidedly dissimilar. The difference is less noticeable in the side views, but is well marked in the end views, and so conspicuous in the top views as at once to attract attention.

By reference to Fig. 71, it will be seen that in the case of right helicoid, the generatrix of one blade, if prololonged on the opposite side of the axis, will generate the opposite blade. We introduce Fig. 105, for the purpose of showing this in another way or rather in a different light. Here we have a square-threaded screw, and we observe that while the generatrix *a b* moves to the position *a'b'*, the portion *a c* generates the upper surface of the thread, and the portion *c b* generates the lower surface: but we have already seen that these two surfaces are identical.

In regard to the V-threaded screw, we believe that the popular idea is that the crest, or outer angle of the thread, is the helix formed by the intersection of two oblique helicoids, generated by lines inclined to the axis at the same angles but in opposite directions. And so far as the mere conception of the object is concerned, this is all well enough: but we deem it worth while to give Fig. 106 in order to show that these two helicoids may be generated by the same line, prolonged beyond the axis. Thus *a b* cuts the axis in *o*, which rises to *o'* while the line *a b* moves to the position *a'b'*; *b e* will then have the position *be'*, and *a e* will appear as *a'e'*, the upper and lower surfaces of the thread being simultaneously generated by the motion of the same line.

It will be seen that the propeller blade in Fig. 102 is a portion of what is in this figure the *upper* surface of the V thread. And in the propeller it is usual to make all the blades alike; so that it clearly would not answer in this case to prolong the generatrix beyond the axis to strike up the opposite blade, since that would result in the production of a surface corresponding to the *lower* side of the thread in Fig. 106.

Such a surface might possibly be considered eligible by

Figure 103.

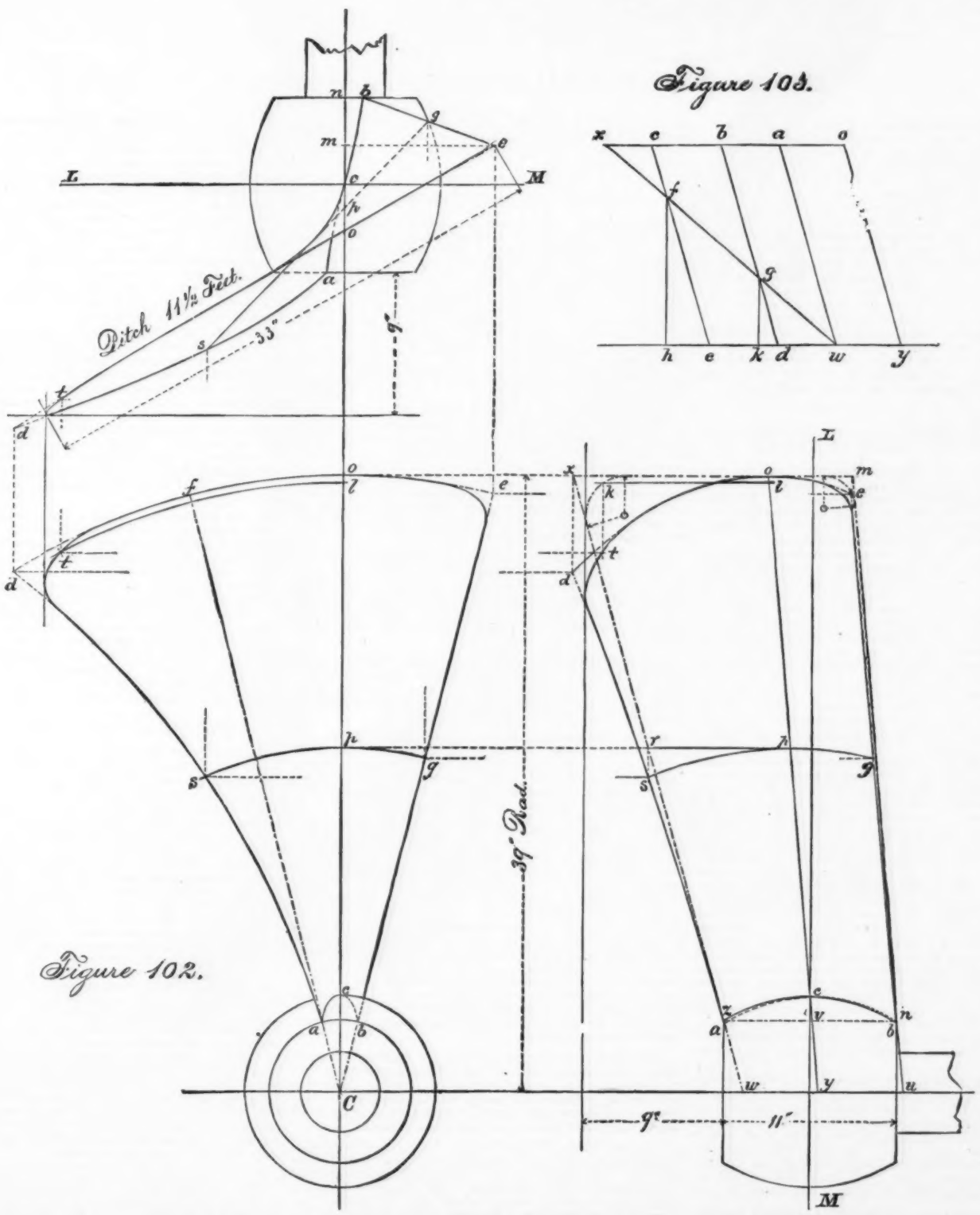
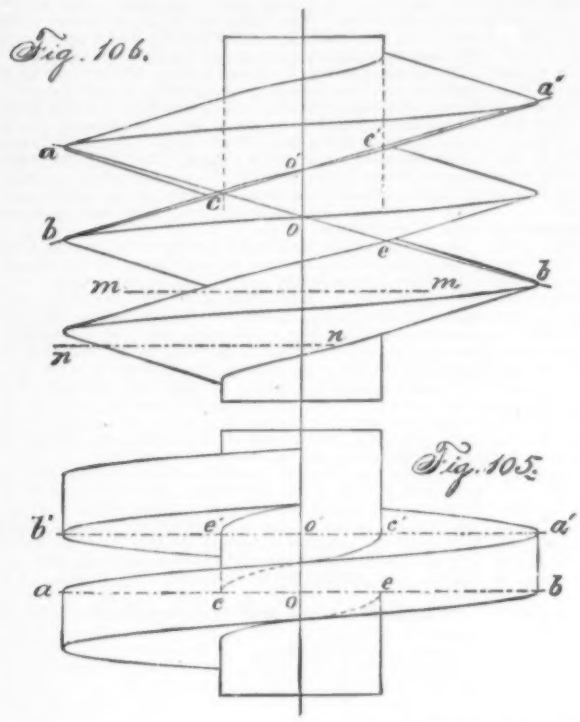
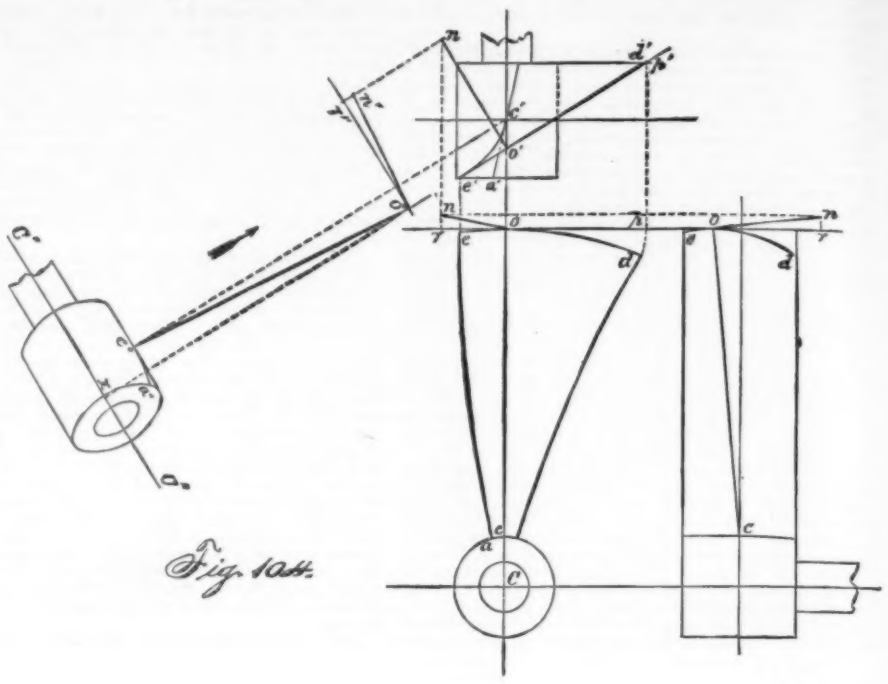


Figure 102.





LESSONS IN MECHANICAL DRAWINGS.—SECOND SERIES.—No. 15.

some, for it is undeniable that very diverse opinions are entertained on this subject: but while this may be open to question, it is quite certain that the drawing of the propeller would not present any difficulties to one who can construct the ones already discussed, so that it is needless for us to illustrate it. But as preliminary to the discussion of what has been alluded to as an oblique helicoid of varying obliquity, which has been used and meets with high favor, we point out that, as may be readily verified by construction, the section of the upper and lower threads in Fig. 106, by planes *m m*, *n n*, perpendicular to the axis, are Archimedean spirals expanding at the same rate, but while one is right-handed the other is left-handed, the view being in the same direction in both cases. It will also be noted that the right helicoid is intermediate between the two; its transverse section is merely a radius, which again is the limit, or dividing line between the two spirals spoken of, whose curvature will evidently diminish the more nearly the generatrix approaches to being perpendicular to the axis, or in other words, the steeper the slope of the groove in the screw.

THE FRENCH EXHIBITION.—REJECTION OF A REMARKABLE AMERICAN EXHIBIT.

ONE of the most remarkable horticultural exhibits ever made was that of Thomas Meehan, of Philadelphia, whose collection on the Centennial grounds numbered no less than 720 kinds of trees. Mr. Meehan is well known as the editor of the *Gardener's Monthly*, and speaks as follows of his efforts to exhibit at the forthcoming French exhibition:

The *whole of these* 730 trees were grown in boxes a year beforehand, and thus were turned out on the Exhibition ground with balls, and the testimony of the Judges on the "growth" of these plants, as given in the award made on them, shows how well this plan worked. This collection, though costing $3,000 (including the commercial value of the trees) to place on the grounds, received comparatively no attention from Americans, but was very appreciatively noticed by foreign papers, and the owner therefore determined to make a similar exhibit in Paris. Our people, knowing how easy it was to overcome difficulties of planting by growing a year in tubs, had no restrictions on time; but in the French rules, we were met at the outset with the regulation that "trees must be in the ground one year beforehand." Supposing, however, that this would not be insisted on after we explained our method, we had near a thousand boxes made, and wrote to see what could be done, but no answer was vouchsafed. Fearing we might have addressed the wrong party, we addressed two others in high connection with the Commission, but still not even the poor courtesy of a reply. Then we made a personal visit to Paris, and were told that they had nothing to do with us—that an American must apply for space through the American Commission; and that in regard to the year-a-head rule—rules were made to be observed. We pointed out that in regard to the American Commission, we had no disrespect to the French people, but the last Congress had quite enough to do to settle our own presidential question; that in any case our Government was not a paternal but a filial one; that we did not propose to send our trees over at the expense of the Government, in a Government ship, but at our own sole, individual expense and risk. Give us 15,000 square feet of ground, and we would plant our trees without thanks to anybody, sending them over this coming Fall, and having everything in readiness when the Exhibition opened. But the only answer was: "You must ask through the American Commission." We returned to America satisfied that we could make no exhibit there.

However, in correspondence with a distinguished French nobleman, we gave a statement of our difficulties, who kindly replied, "I am sorry to see that, though you could not exhibit in a national capacity, you could not either arrange for a private exhibition of your hardy trees at the great exhibition of Paris next year. As the Duc d'Audiffret Pasquier, President of the Commission, happens to be staying with me, I gave him an extract from your letter, and he will see whether it is still possible to arrange the matter to your mind."

The Duke kindly interested himself as promised, and sent a letter to Mr. Meehan, the plain English of which was that he must apply to a Commission that does not exist, and which, if it did exist, would still be too late to come within the "year-planted" rule. "How Not to Do It" was never better illustrated.

BAHAMA AND TRINIDAD TIMBER.

THERE are many timber trees here which have such valuable properties that it will be worth while to enumerate a few, commencing with Bahama. The cedar of that island is used principally in house-building, for door and window frames, piazza posts, sills, girders, etc. It grows on several of the Bahama Islands, but is found in greater abundance on Andros Island, and its size, when full grown, is from 16 to 20 ft. in length, and 1 ft. in diameter. It is generally cut 10 to 16 ft. in length, and from 5 to 8 in. square. The branches are used for boats' timbers. This is one of the most durable of the Bahamian woods. It is a soft, close-grained, rather light wood, possessing the pink hue, and emitting the fragrant odor of the common pencil cedar.

Horseflesh Mahogany is sold at fancy prices here, when good specimens are offered; but in Bahama it is principally used in house-building, and the branches and crooked trees for ships' timbers. It is a very durable wood, and grows on several of the Bahama Islands, but is found of large size and in greater quantities at Andros Island, where it grows to about 20 ft. in length and 2 ft. in diameter. It is, however, seldom brought out of the woods at that size, for want of proper means of conveyance. It is a hard, fine-grained wood, and exhibits numerous open cells.

Dogwood.—The principal uses made of this wood are for felloes of wheels, and for ships' timbers. From its toughness and other properties, it is better adapted to the former purpose than any other of the Bahamian woods. The tree does not attain any considerable size, and is generally crooked. A rather soft, open-grained, but very tough wood.

Stopper Wood is principally used for piles and for wheel-spokes. It is a very strong and durable wood, and grows from 12 to 16 ft. long, and from 6 to 8 in. diameter. It is found on all the Bahamian Islands, and is an exceedingly hard, fine, close-grained, and very heavy wood.

Lignum Vitæ grows on several of the Bahama Islands, and is generally exported to Europe and America. The principal use made of it in the Bahamas is for hinges and fastenings for houses situated by the sea-shore, or in the vicinity of salt ponds on the out islands, where, from the quick corrosion of iron hinges, etc., metal is seldom used.

Bahama Satinwood, so well known in the London market, and also called yellow wood, grows abundantly on Andros Island, and others of the Bahama group, and to a large size. It is a fine, hard, close-grained wood, showing on its polished surface a beautifully-rippled pattern. Bahama mahogany grows abundantly on Andros Island, and others of the Bahama group. It is not exceeded in durability by any of the Bahama woods. It grows to a large size, but is generally cut of small dimensions, owing to the want of proper roads and other means of conveyance. It is principally used for bedsteads, etc., and the crooked trees and branches for ships' timbers. It is a fine, hard, close-grained, moderately heavy wood, of a fine, rich color, equal to that of Spanish mahogany, although probably too hard to be well adapted for the purposes to which the latter is usually applied.

Crab Wood is mostly used for picture frames, and small ornamented cabinetwork, etc. It seldom grows larger than from 3 to 4 inches in diameter, and is a rather hard, fine, close-grained, moderately heavy wood. The heart-wood is of a beautifully-veined Vandyke brown, its external edge bright black, and the alburnum of a pure white.

Trinidad Woods.—The balata is a timber extensively used for general purposes, and much esteemed. Its diameter is from 2 to 6 ft. The mastic is also held in high estimation, and varies from 2 to 4 ft. in diameter. The gru-gru, which is a palm, yields beautiful veneer, as also does the gri-gri. For some of these trees it will be observed that we have no vernacular names, consequently the choice lies between the native and botanical name. The heart-wood of the butter-wood only is used. The beauty of the wood is well known, but it never attains a large size. Its recent layers are of an uniform yellowish white color. The carapa bears a considerable resemblance to cedar, and is extensively used, and much esteemed. It is from 2 to 3 ft. in diameter. The West Indian cedar of Trinidad is a most useful timber, growing to from 3 to 12 ft. in diameter, and is well deserving the attention of consumers, as is also the copia, a beautiful and durable wood. The sepe is a light wood, resembling English elm, impregnated with a bitter principle, which preserves it from the attacks of insects. It is much valued, and its diameter is from 1 to 2 ft. The calabash is very abundant. It is tough, strong, and is used for general purposes. In diameter it ranges from 1 to 2 ft.

L'Angelme is a strong, hardy wood, exclusively used for the naves of wheels, etc. Courbaril is a valuable and abundant timber of from 2 to 6 ft. in diameter, and may be otherwise described under the name of West India locust. Yorke saran is a very hard and useful wood, and also purple heart, which has the advantage of being very abundant, and runs from 2 to 4 ft. in diameter. Aqua-Tapana is a very durable and curious wood susceptible of high polish, and from 18 to 36 in. in diameter. The green, gray, and black poni furnish the hardest and most durable of wood. Their timber takes a fine polish, has a peculiar odor, and is very abundant. The trees are 3 to 4 ft. in diameter, and proportionately lofty.

It will be seen that much valuable wood is produced at places where we do not usually look for it, unless for some particular production which we happen to be acquainted with, such as Bahama satinwood, etc., and for the most part we are content to take the products of the forest just as they come to our hands, and with few attempts to improve the quality of the wood by cultivation. But the great value of forests, as sanitary agents, and their value as an annual source of revenue, are now beginning to be appreciated, and it may be that another generation will not only find that the supply of building wood is more abundant in proportion to what will, no doubt, be an increased consumption, but also that the durability and beauty of our imported woods have been enhanced by proper cultivation.—*Building News.*

TRAVELS OF THE POTATO BEETLE.

CAPTAIN JOHN EVANS, of the schooner H. E. Riley, informs us that on a recent trip from Cienfuegos, Cuba, to Boston, when fully 100 miles from land, east of the capes of Virginia, his vessel was boarded by a party of several hundred Colorado potato beetles. This was about October 7th, and there was a heavy wind from the north-northwest. A few days previous he had encountered the cyclone, which people of the coast remember well as having prevailed about that time. The insects were evidently aided in their journey to this distance from land by the wind. Some of them were thrown overboard, spread their wings before reaching the water, and flew about easily, a few returning to the vessel.

This incident shows that insects may thus be blown far to sea, and alighting upon vessels, be borne to Europe or other countries, in spite of precautions against their introduction aboard ship. Captain Evans says that he has seen potato beetles in large numbers on the decks of vessels at Philadelphia and New York, without regard to their presence in freight packages. In the case of steamers which make the voyage to Europe in ten or twelve days, it is quite possible for the beetle to live, it seems to us, on such fare as he would find aboard, and walk out smiling on the other shore. Or if he did, he, or rather she, would doubtless leave enough live eggs behind—even without the encouragement of a potato leaf—to insure the advent of her offspring in the new land.

Captain Beal, of the bark Neptune, Boston, informs us that on his last visit to Cuba, he heard of an insect which had attacked the sweet potato there. During his next trip he intends to investigate the relation of this chap to the gentleman from Colorado.—*Scientific Farmer.*

THE TRANSPORT OF MONOLITHS.—The huge granite monolith which supports the horse of the statue of Peter the Great at St. Petersburg was rolled from Finland to St. Petersburg upon cannon-balls.

DESIGN FOR HARP.

OUR engraving shows a harp carved in black stained pear, enriched with buhlwork, the appliqué ornaments in silvered bronze. Designed by Prof. Wollanek, Vienna.

THE WONDERFUL FOSSIL BEDS OF OREGON.

A CORRESPONDENT of the Eugene City (Oregon) *Guard* gives the following account of a visit made last June by himself and another person to the fossil beds of Lake County, that State: Silver Lake and Summer Lake lie on the confines of the desert, by the crossing of which much suffering was experienced by the early Oregon pioneers. Silver Lake is encompassed by "rim-rock," except on the northwest. On the east there is a gap which leads into a basin nearly circular, and which is probably 30 miles in diameter. This basin is surrounded by rim-rock on the south, southwest and west, rising to the height of several hundred feet, with occasional breaks or cañons, sloping into the basin. On the north and northeast of the basin the ascent is more gradual, but at a distance presenting an uninterrupted barrier. The surface of this basin is comparatively level, being subject, however, to slight inequalities in the form of hillocks or low ridges rising but a few feet.

The soil, if we may venture to call it soil, seems to be composed of light sand and volcanic ash, with a percentage of vegetable mould, into which a horse will frequently sink to his fetlocks. Near the center of this basin, and about 18 miles from Silver Lake, in a northeast direction, is "Christmas Lake;" 8 miles from Christmas Lake, in the same direction, and apparently on the same level, are Fossil Lakes. About 5 miles further on, in the same direction, are two springs of tolerably good water. These springs are about half a mile apart. I heard the most northerly called Duncan's spring, and we called the other Mound Spring. The rocks about Silver Lake and Summer Lake, where stratified, appear to dip to the north.

From 20 to 40 miles in a northwest direction from the Fossil Lakes, set in the lava mountains, or rather mountains of lava It would seem that these fossil remains might have remained buried from 4 to 10 feet in the earth, and, therefore, unknown to the prying eyes of the antiquarian, but for the action of the wind. There seems to be a constant current of wind from the southwest. All that space where the bones are found appears to be scooped out to the depth of several feet, and carried, some of it, to a distance of from 5 to 10 miles, where it is piled up in every conceivable form. evidently by the action of the wind; conclusive evidence of this is found in the numerous little mounds still remaining, and able to resist the action of the wind by the aid of the roots of some more vigorous bunch of sage or greasewood. These mounds present a beautiful example of stratified formation, often 5 or 6 strata, ranging from 3 to 8 inches in thickness, very clearly marked. On the lower levels of this excavation are where the fossils are found. We found fossil bones of the elephant, camel, horse, and elk or reindeer, the horse being much more abundant than either of the others, but all being so clearly marked as to leave no doubt as to their identity. There were other bones, apparently of large animals, but your correspondent was unable to name the animal they once belonged to. Among the fossils found the smaller quadrupeds had a representation; bones answering in size to the fox and wolf were found, also others answering to the sheep or goat in size and appearance. Remains of birds were very plentiful, some very large, others quite small. Waders, swimmers, scratchers, and probably climbers, were recognized. The vertebræ or backbones of fish, or some other animal with a backbone like the fish, are found in great plenty; also bones like nothing I ever saw before, therefore, I will not undertake to describe them.

The fossil remains lie scattered over the earth for a distance of 4 or 5 miles in the direction of northeast and southwest, the strip being probably a mile wide. Near the southwest end of the deposit are two small lakes or ponds, highly impregnated with alkali, the water having a milky appearance, with a disagreeable taste and smell. I have presented to Professor Thomas Condon of the State University, to whom I was largely indebted for valuable suggestions as to the manner of selecting and packing specimens, the most of my find, retaining but few duplicates myself.

HARP; DESIGNED BY PROF. W. WOLLANEK, VIENNA.—*From the Workshop.*

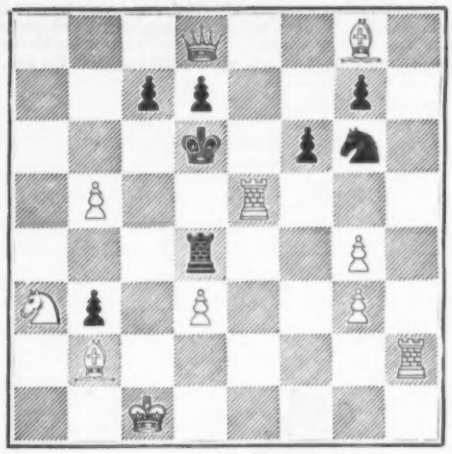
SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department, may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM No. 33. By R. B. WORMALD.

Second Prize.—*Lebanon Herald* Tourney.

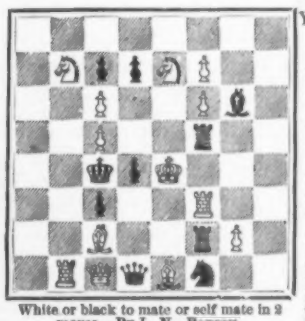
Black.



White.

White to play and mate in two moves

R. B. WORMALD, OF LONDON.



White or black to mate or self mate in 2 moves.—By J. N. BARSON.

IN the introduction of Mr. Wormald to our readers we continue the record of the *Lebanon Herald* Problem Tourney, as well as the sequence of England's distinguished masters, who have taken charge of the chess department of the London *Illustrated News*.

For many years Mr. Wormald had conducted the chess department of *Bell's Life*, and was not only well known as a strong player and distinguished problemist and author, but was also an authority on sporting matters, and was generally selected as umpire on all important aquatic matches. He has been for many years Mr. Staunton's right hand man, and was, therefore, eminently fitted to fill the place of that great writer.

Mr. Wormald was born in Yorkshire in 1834, and was but forty-three years of age at the time of his death. He was universally beloved and admired, and his loss has been mourned by the entire chess fraternity.

We met him in Paris during the Exhibition of '67 and spent a pleasant day with him in company with De Vere. We made a little drawing of these rival English champions at the time, and reproduce the portrait of Mr. Wormald, and will shortly give that of Mr. De Vere. The likenesses are very correct, which will make amends for the hasty manner in which they were executed. We also produce a game that was played between these departed champions in their encounters for the English "Challenge Cup" of that year.

We will here remark *en passant* that we have this week received a most delightful visit from Mr. Duffy, the present chess editor of the London *Illustrated News*, as well as the *Westminster Papers*. Mr. Duffy is making a flying visit to the States, and will return very shortly.

THE DETROIT FREE PRESS AWARD.

Having been a competitor in the above tournament, allow me, while calling attention to the solutions given this week, to say that my set being well thought of, many problemists—even one of the victors—wrote, saying they thought the umpire had slipped up, and that mine was the best set of the tournament. In my foolishness I flattered myself that it might be so, but had the wisdom to refrain from expressing my views on the subject.

Now that we have published the winning problems, and studied the beautiful features of the two-move problem, from the oddity of the key move to the marvelously elaborate terminations resulting from the moves of the defence, as well as in the self-mate, where the idea of a waiting position is so completely hidden by the masterly skill with which the idea has been treated, I not only heartily endorse the umpire's award, but consider Mr. Shinkman's set so far superior that, had the umpire made the blunder of awarding me the prize, I should have felt called upon to protest against receiving it. Doubtless some of the critics smile at this assertion, for such a sense of justice can hardly be expected to be appreciated by those who have yet to learn to be beaten gracefully.

At the Paris Tournament the committee consisted of Mr. Kolisch and Mr. De Vere. From the nature of the tournament the authorships were known. The umpires gave the verdict in my favor, Mr. Kolisch voting that the sets were of equal merit, whereas De Vere gave an unqualified preference for my set. Having seen the problems, and knowing that Bayer's was the best, and that he had fairly won the first prize, and that the award was due to Mr. De Vere's inexperience—I asked for a reconsideration of the award, remarking that it was no disgrace to be beaten by Conrad Bayer—and that he was fairly entitled to the prize, and the award was, therefore, so amended.

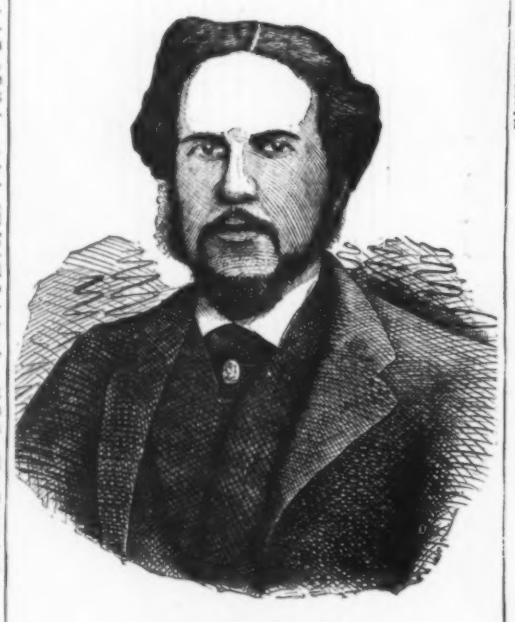
I have just received the award of the *Cleveland Sunday Voice* Problem Tournament, ninety-one problems entered. First prize, F. W. Martindale; second prize, Samuel Loyd; third prize, W. A. Shinkman. Problems and portraits in due season.

That our readers may the better understand my reference to the *Detroit Free Press* Tourney, I give the best of my positions, which, by the way, received favorable notice from the umpires. On the point of difficulty I think it would rate higher, but for beauty of idea and merit of construction, it is so far inferior to Shinkman's that none but the most fanatical advocates of difficulty would give it the preference.

WORMALD AND DE VERE.

PLAYED in the "Challenge Cup" Tourney of the British Chess Association in 1869.

WORMALD. WHITE.	DE VERE. BLACK.
1. P to K 4	1. P to K 4
2. Kt to K B 3	2. Kt to Q B 3
3. B to Q Kt 5	3. P to Q R 3
4. B to Q R 4	4. Kt to K B 3
5. Castles.	5. B to K 2
6. Q to K 2	6. P to Q Kt 4
7. B to Q Kt 3	7. Castles.
8. P to Q 3	8. B to Q Kt 2
9. P to Q R 4	9. P to Q Kt 5
10. B to K 3	10. P to Q 4
11. P x P	11. Kt x P
12. Q Kt to Q 2	12. P to K B 4
13. B to K Kt 5	13. B x B
14. Kt x B	14. Kt to Q 5
15. Q to K R 5	15. P to K R 3
16. B x Kt ch	16. B x B
17. K Kt to B 3	17. Kt to K 7 ch
18. K to R sq	18. Kt to K B 5
19. Q to K R 4	19. Q x Q
20. Kt x Q	20. P to K Kt 4
21. K Kt to B 3	21. P to K 5
22. Kt to K sq	22. P x Q P
23. P x P	23. Q R to K sq
24. P to Q Kt 3	24. R to K 7
25. R to Q sq	25. Kt to K R 6
26. P to K B 3	26. Kt to B 7ch and white resigns.



R. B. WORMALD.

THE INTERNATIONAL CHESS CONGRESS IN PARIS.

IT was announced some time ago that a movement was set on foot in France for the purpose of arranging a grand International Chess Congress, to be held in Paris during next year's Exhibition, and we have now the greatest pleasure in informing our readers that the project is now in the fairest way of being successfully realized. M. Rosenthal, who has the preliminaries in hand, has received assurances from most influential authority that the French Government will follow the example set by the late Emperor Napoleon during the Paris Exhibition of 1867, and of the present Emperor of Austria during the Vienna Exhibition of 1873, who offered handsome prizes for the winner of the chief tournament on those occasions. A committee is being formed to settle the regulations of the various chess competitions, and to receive subscriptions, which will enable the managers of the Congress to offer some other prizes, in order to attract the participation of the strongest chess players throughout the world.

The American players have awoke to a sense of the situation, and the new Chess Association have a plan under consideration for holding a grand tournament to select the strongest player to be sent over as our representative American chess player.

The Association Problem Tournament is beginning to attract the attention it deserves. The *St. Louis Globe Democrat* sets the ball rolling by publishing the first problem of the tournament under the motto "Around the World in Eighty Days," and offers five dollars for the best tournament problem received by the *Globe*. A card from ourselves is published in the *Cleveland Sunday Voice*, re-offering the amount of our *Voice* prize ($10) for the most difficult problem. A liberal member of the Association from New York proposes to offer twenty dollars through the *Turf, Field and Farm*.

Our worthy treasurer, Dr. C. C. Moore, is determined not to be outdone in liberality, and requests us to offer the amount of the several prizes he has lately won (amounting to about thirty dollars) in the shape of an elegant inlaid chess board, made of upwards of twenty-two hundred pieces of wood, for the best letter problem received by this journal prior to the date of the awarding of the Association prizes. In thanking the Dr. for his liberality, we insist, however, that he must again enter the lists, as some of our knights have expressed the desire to break another lance with him, in which case we will be pleased to add an appropriate trophy for second prize.

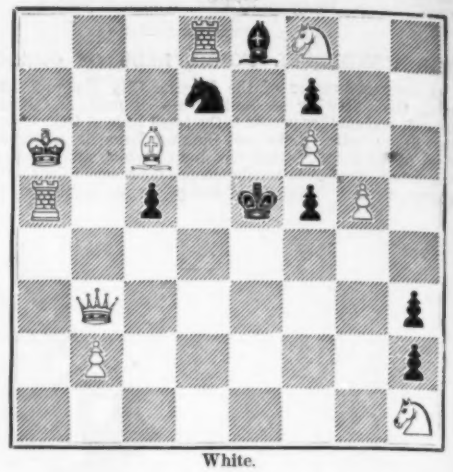
The interest of these tournaments should not draw the attention of our chess friends from the all-important necessity of enrolling their names as members of the Association: address the Secretary, J. B. McKim, Cleveland, O.

A British Problem Association has been formed, and a programme will shortly be issued. An objectionable feature is spoken of, however, which limits the competition to England. Surely, the rising fame of Master Harry Boardman, Frank Norton, and Simon Fleischman (the eldest of whom is but fourteen) has not suggested the necessity of home protection. We trust the Press is misinformed on the subject. England's leading problemists would never countenance such an international discourtesy.

PROBLEM No. 34.—By C. M. BAXTER, Dundee, Scotland.

Third Prize. *Lebanon Herald* Tourney.

Black.



White.

White to play and mate in two moves.

SOLUTIONS TO PROBLEMS.

No. 27.—By W. A. SHINKMAN.

WHITE.	BLACK.
1. B to Q R 2!!	1. K x R or B to Q 5
2. Q to K 7 mate	
	1. B to Kt 7 or B 6
2. Q x B mate	
	1. Q B moves
2. Kt to Q 7 mate	
	1. Kt x R
2. Kt to Kt 6 mate	
	1. Kt elsewhere
2. Q to Q 6 mate	
	1. R to B 5
2. R to K 6 mate	
	1. R elsewhere
2. Kt to Kt 4 mate	
	1. K Kt moves
2. R to B 5 mate	

No. 28.—By W. A. SHINKMAN.

WHITE.	BLACK.
1. Kt to K sq	1. B to Kt 7 or Kt to B 3
2. Q to B 4 ch	2. K x Q dis mate
	1. R x Q or Kt
2. R to B 4 ch	2. B x R mate
	1. R x P
2. Kt to Q 6 ch	2. R x Kt mate
	1. B to R 6 ch.
2. Q to B 5 ch	2. B x Q mate
	1. Kt to K 2 or R 3
2. Q to Q 4 ch	2. K x Q dis mate

Letter "N."—By W. A. SHINKMAN.

WHITE.	BLACK.
1. Q to K B 6	1. Any move
2. Mates accordingly	

ENIGMA No. 1.—By S. LOYD.

Free Press Tournay.

White.—K on K B 3, Q K Kt 5, Rs K Kt 3, and K R 4. Bs K R 2 and Q B 2, Kts Q 8 and Q B 8.

Black.—K on K 4, Q K Kt 8, Rs K R 8 and K Kt 7, B K B 4, Ps Q 4 and 5, K 6 and 7, and K R 6.

White self mates in two moves.

STAUNTON says: "Never forget that in chess, as in modern warfare, one of the most important stratagems is the art of gaining *time* upon the enemy. In this respect, as in many others, the broad principles which are laid down by the highest military authorities as the basis of operations in a campaign are applicable to the management of your forces on the chess field. From the *Traite de Grande Tactique* of General Jomini, we gather that the art of war, as exemplified by Bonaparte, consisted in the proper application of three combinations—first, the art of disposing the lines of operation in the most advantageous manner; secondly, in a skillful concentration of the forces with the greatest possible rapidity upon the most important point of the enemy's line of operations; and thirdly, that of combining the simultaneous employment of this accumulated force upon the position against which it is directed. No player of great skill can fail to see that we have here the key to the basis of offensive movements in the battle of chess."